TROPICAL PLANTING AND GARDENING

WITH SPECIAL REFERENCE TO CEYLON

H. F. MACMILLAN

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AMHERSTIA NOBILIS, WALL.

QUEEN OF FLOWERING TREES.

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AND

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H. F. MACMILLAN

FOURTH EDITION

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AND
GARDENING

WITH SPECIAL REFERENCE TO CEYLON

BY

H. F. MACMILLAN

(Late Superintendent, Royal Botanic Gardens, Ceylon, and Adviser to the Anglo-Persian Oil Company)

FOURTH EDITION

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FOREWORD

RECENT years have seen the issue of a number of new books relating to the agriculture and horticulture of the tropics and sub-tropics, but in spite of this the demand for Macmillan's *Handbook on Tropical Planting and Gardening* has been maintained. It is recognised as a standard work which can be recommended with confidence, and a new edition will be welcomed.

The present edition has been considerably revised and certain sections have been completely rewritten. It will be appreciated by all who are interested in or connected with agricultural or horticultural undertakings in the tropics, and particularly by residents who are desirous of establishing or improving their gardens. As a guide to those proceeding to the tropics for the first time it should be invaluable.

F. A. STOCKDALE.

Feb. 19th, 1935.

ABBREVIATIONS

Sp. = species (plural, spp.).
Var. = variety (plural, vars.).
Hort. = of gardens, as a variety, cross, or sport.
Nat. = naturalised.
Lvs. = leaves, foliage.
Fls. = flowers, inflorescence.
Fol. = foliage.
Tr. = tree.
Sh. or shb. = shrub.
Cl. = climber.
Cr. = creeper.
Ep. = epiphyte.
Terr. = terrestial; living on the ground.
Tu. = tuber.
Rhiz. = rhizome.
Off. = offset.
Su. = sucker.
Prop. = propagation.
S. = seed.
C. = cuttings.
Lay. = layers.
A. = annual.
Hp. = herbaceous perennial.
Med. = medicinal.
Fig. = figure, illustration.
S. (*italic*) = Singalese.
T. (*italic*) = Tamil.
Q.V. = which see.
Syn. = synonymous with.

PREFACE

THE demand for a fourth edition, which has arisen much earlier than expected, has given the writer an opportunity of amplifying and bringing the matter up to date, while at the same time effecting certain amendments. The classified arrangement of the different subjects according to their uses, etc., is adhered to, this being considered to be the most convenient for those who wish to cultivate plants for ornament, utility, or commercial purposes, or who may desire brief information concerning their properties.

Though the pages have been somewhat condensed, in order to reduce bulkiness as far as possible, the general matter has been considerably added to. The illustrations have been increased in number and variety, and an extra chapter is devoted to Arid or Sub-desert Regions, where the need for introducing suitable species or varieties and for the study of special methods of cultivation is keenly felt. The wide variety of subjects dealt with makes it impossible to deal with each in greater detail than is practicable in a single volume like this, but where fuller information is desired there is no lack of books dealing with single subjects only. Though this work was originally intended mainly for Ceylon, where are found a variety of climatic conditions and a wealth of vegetation, indigenous or exotic, cultivated or wild, not commonly met with elsewhere in the tropics, it was subsequently deemed advisable to make it of wider application.

I owe a debt of gratitude to several friends for help and advice, more especially to Mr. A. E. Mackintosh, B.Sc., Agricultural Chemist, India, who has made valuable additions to the article on Fertilisers, Mixtures, etc.; to Mr. J. H. Holland, F.L.S., late of the Economic Museums, Royal Botanic Gardens, Kew, for much valuable information and helpful suggestions; to Mr. C. Drieberg, B.A., late Superintendent of Agriculture, etc., Ceylon, for many useful hints and advice; and to Mr. W. F. Hunter, of Henry Diaper & Co., London, for special information on rubber. For unvarying courtesy and facilities for reference, I have to thank the Directors and members of the staffs of the Imperial Institute and of the Royal Botanic Gardens, Kew. I have also to thank Mrs. V. Higgins, M.A., Secretary, Cactus and Succulent Society of Great Britain; The European Grain Agency, Ltd.; The Australian Trade Publicity Agents; and Messrs. Shanks & Sons, the well-known lawn-mower manufacturers, for the loan of photographs and blocks.

I again wish to express my indebtedness to the following for their much valued assistance in the preparation of the last edition, viz., R. O. Iliffe, M.A., late Economic Botanist, Department of Agriculture, Ceylon;

Dr. C. H. Gadd, Mycologist to the Tea Research Institute, Ceylon; F. P. Jepson, M.A., Entomologist, Department of Agriculture, Ceylon, John Parkin, M.A., F.L.S., and others previously mentioned.

For unfailing encouragement I am particularly indebted to my late chief, Mr. F. A. Stockdale, C.M.G., C.B.E., M.A., F.L.S., Agricultural Adviser to the Secretary of State for the Colonies, who has favoured me with a foreword for this and the previous edition.

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CHAPTER I

CLIMATE AND SOILS

Climate. Climate is the principal factor which controls the growth of plants, and constitutes the conditions which render a country suitable for the abode of man and animals. One of the first questions the planter or gardener in the tropics has to consider is whether the climate is suitable for the cultivation he intends to take up. Climate mainly depends upon latitude and altitude; it is (*i.e.* the mean) usually hottest at the equator at sea-level, and coldest the further away from it and the higher above sea-level. It is also, however, materially affected by the distance from the sea, form and slope of the land surface, nature of the soil and vegetation, and by other circumstances. The influence of altitude is specially noticeable in the tropics, the temperature becoming appreciably cooler as one ascends the hills. Thus, whilst at Colombo it is hot and tropical, at Nuwara Eliya, 6,000 feet above sea-level, it is cool and fairly temperate. For about every 300 feet of elevation there is a reduction of about one degree in the temperature, and it is estimated that for about every 270 feet elevation the effect on the temperature is equivalent to receding a degree from the equator. Thus, Kandy being about 1,500 feet above sea-level, its average shade temperature is about 5 degrees cooler than that of Colombo. At Nuwara Eliya the difference is even more marked, so that if Pidurutalagala, the highest mountain (8,296 feet) in Ceylon, were some 8,000 feet higher still, it would probably be covered with perpetual snow. The cooler climate of the hills not only renders possible the cultivation of certain plants or crops of temperate regions, but also affords residents and visitors a grateful substitute for the more bracing climate of a temperate country. The flat northern and eastern portions of Ceylon are characterised by a dry arid climate, to which typical forms of thorny vegetation or scrub are indigenous. Here, however, certain plants and crops may thrive better than in the wet zone, being specially adapted (*xerophytic*) to an arid climate as, for example, the Palmyra palm, which in the drier zone luxuriates and forms a valuable product.

In Ceylon, for example, there occur four distinct types of climatic zones, viz.: (1) *hot and moist zone*, from sea-level to about 1,500 feet elevation, with a well distributed rainfall of 80 to 120 or more inches and a mean shade temperature of about 80° F.; this is confined to the south-western part of the island; (2) *hot and dry zone*, formed by the flat low country of the northern and eastern parts of the island, with a rainfall confined to only a few months of the year; (3) *intermediate zone*, from 2,000 to 4,000 feet altitude, with a rainfall of 80 to 130 or more inches; (4) *montane* or *cool zone*, from about 4,000 feet to the highest altitude (8,296 feet), with an evenly distributed rainfall of 85 to 150 or more inches.

During the months of January and February cool night temperatures are usually experienced; thus at Colombo a night temperature of 65° F., at Kandy of 50° F., and at Nuwara Eliya 29° F. is sometimes recorded. Such a diversified climate allows of the cultivation of a large variety of plants or crops from different countries. Consequently there may be seen in Ceylon and similar countries a considerable number of acclimatised plants from other climes, many having become naturalised.

Seasons. The line is faint that divides the seasons in the tropics. No period of the year is entirely without flowers or fruit, some species producing both at all or various periods of the year. Many plants have two distinct seasons of flowering and fruiting. In Ceylon, for example, the uniform moist climate of the south-western districts is only varied by a period of comparatively short rainfall between January and March, *i.e.* the "dry season." No "cold season" occurs here as in India and other countries in similar latitudes, though during the dry season, as well as in the hotter months (March to May), most people prefer to adjourn to the more bracing air of the hills, which is then dry and crisp. These changes are brought about by the two annually recurring monsoons, viz. the *south-west* monsoon, commencing at the end of May and lasting till October, and the *north-east* monsoon, occurring from October to May. The rainfall of the former is more or less confined to the south-west of Ceylon, while the eastern side of the country receives its most copious rain from the north-east monsoon, chiefly in November and December, its driest season being from June to September. In the northern and eastern parts of the island, the rainy season is mostly confined to the three months of October to December, very little rain falling from April to September. The hottest period of the year, all over Ceylon as well as in S. India, Malaya, etc., is from March to the end of May.

LOCAL INFLUENCES ON CLIMATE

Forests constitute one of the most important conditions affecting climate. Their presence prevents erosion of the soil, retards the evaporation of moisture, enables the soil to retain a large proportion of rain water, and tempers the atmosphere both by cool vapours from the ground and by checking radiation. It is sometimes claimed that forests indirectly also cause precipitation of the clouds, resulting in more frequent showers. When forests are cleared away, radiation from the land is increased, the soil is less retentive of moisture, and the air as well as the soil becomes drier and hotter. A similar result naturally occurs when swampy or marsh land is drained and reclaimed. The climate of islands and maritime districts is usually more equable than that of the interior of continents, the atmosphere in the former being frequently laden with clouds and vapours. Lakes, marshes and rivers, however, have usually an unfavourable effect on climate, as they give rise to fogs, especially at night, which chill the ground and render the vicinity less healthy.

Aspect has an important influence on climate, a northern or eastern being, as a rule, cooler and moister than a southern or western aspect. In a north verandah, for example, plants which require a cool temperature thrive better than in a verandah facing south, *i.e.* in the northern hemisphere; in the southern hemisphere the reverse is the case. In a mountainous country, aspect is of course often affected by the lie of the land; thus, high ridges, alternating with valleys or ravines, often cause an appreciable difference in the climate of places relatively near to each other. Similarly in a narrow valley, while one side, being partially shaded, may be cool and damp, the other may be warm and dry, so that plant-life may differ materially on either slope.

Wind-breaks. Local climatic conditions may be improved by the planting of suitable shade and wind-break trees, for these not only break the force of strong winds, but also tend to lessen the excessive evaporation of moisture and temper the sun's rays. Thus places so sheltered may have local climatic conditions appreciably different from exposed and windy situations. Wind-breaks may therefore be said to be as essential to many plantations as a breakwater is to an open harbour.

Soil Formation. Climate is also affected by the nature of the soil, there being greater radiation of heat from sandy than from clay soils; thus districts with light sandy soils have usually the highest day temperatures, the night temperature, however, being as a rule proportionately cooler. This largely accounts for the intense heat of desert regions during the greater part of the year.

Irrigation, it is admitted, has a marked beneficial effect on climate; thus the enormous lake-like dams or reservoirs, like that at Assouan in Egypt for accumulating the Nile waters, and others in India and Ceylon, are assumed to have an important influence in cooling the surrounding atmosphere. (See *Irrigation*, p. 33.)

Table showing Elevation, Average Rainfall, and Mean Temperature at a few of the Principal Recording Stations in the following Countries

	Elevation in Feet.	Average Inches.	Rainy Days.	Average Temp., Fahr. degrees.
Ceylon:—				
Agrapatana (Holmwood)	5,240	104	200	60
Anuradhapura	295	55	105	81
Avisawella	105	153	174	—
Badulla	2,225	72	133	73
Bandarawela	4,036	71	135	67
Batticaloa	Sea-level	63	104	81
Bogawantalawa (Campion)	4,500	98	209	65
Chilaw	Sea-level	49	111	81
Colombo	,,	79	180	80
Deltota (Pattiyagama)	3,500	106	165	70
Diyatalawa	4,140	63	158	67
Galle	Sea-level	90	196	80
Gampola (Mariawatte)	1,600	106	183	—
Hakgala Gardens	5,581	93	225	60
Hambantota	50	38	87	80
Haputale	4,800	82	151	—
Hatton	4,143	144	222	69
Henaratgoda (Gampaha)	33	100	145	—
Jaffna	Sea-level	49	74	81
Kalutara	,,	100	162	—
Kandy	1,654	83	193	76
Kegalla (Jail)	Sea-level	105	193	—
Kegalla (Ambanpitiya)	729	107	160	79
Kurunegala	381	80	162	80
Mannar	Sea-level	38	68	82
Matale	1,208	79	143	76
Matara (Hospital)	Sea-level	70	174	80
Nawalapitiya (Kenilworth)	2,500	205	220	70

	Elevation in Feet.	Average Inches.	Rainy Days.	Average Temp., Fahr. degrees.
CEYLON :—				
Negombo	Sea-level	69	109	81
Nuwara Eliya	6,188	92	203	59
Peradeniya Gardens	1,540	88	161	75
Puttalam	Sea-level	44	83	80
Ratnapura	84	150	223	80
Trincomalee	110	63	106	82
Welimada	3,300	54	123	67
INDIA, etc. :—				
Allahabad	309	44	48	70
Baghdad (Iraq)	120	6	27	71
Basrah (Iraq)	78	5	15	75
Batavia (Java)	26	72	138	79
Bombay	37	72	72	80
Calcutta	21	63	85	79
Cochin	9	115	129	80
Jesselton (N. Borneo)	—	102	149	79
Karachi	13	7	9	76
Madras	22	50	57	96
Malacca	23	86	—	80
Manila (Philippines)	47	44	143	79
Penang	17	105	164	82
Rangoon	18	99	122	81
Trivandrum	198	65	94	78
AFRICA, etc. :—				
Accra (Gold Coast)	53	28	45	79
Aden	98	1	3	83
Cairo	379	1½	9	69
Calabar	40	125	167	79
Daressalem	25	41	104	77
Entebbe	3,640	59	136	70
Freetown (Sierra Leone)	224	159	157	81
Khartoum (Soudan)	1,280	5	15	83
Lagos	22	73	123	85
Mombasa	50	47	1[illegible]	78
WEST INDIES, etc. :—				
Bahamas (Nassau)	12	50	132	77
Guiana (Georgetown)	6	87	208	80
Jamaica (Kingston)	110	31	79	79
Porto Rico (San Juan)	82	64	214	78
Trinidad (Port of Spain)	72	63	174	77

FORMATION OF SOILS

Soils are formed by the gradual decomposition or wearing away of rocks, under the influence of weather, glacial or volcanic action, assisted by the presence of plant-life. Variations of temperature also have an important effect on the formation of soils, for rocks expand with heat and contract with cold. Thus in hot tropical sunshine, the surfaces of rocks expand, and are again contracted by the cool air of the nights; this causes them to crack, and particles crumble off, thereby giving rise to a small but constant addition to the soil. Plant-life assists in the formation of soils in two ways, *i.e.* mechanically and chemically. The roots enter crevices of rocks and, by their gradual increase in bulk, act like wedges in forcing the two sides apart; the force thus exerted is considerable, being sometimes sufficient to break through concrete or lift

stone pavements. Roots have also, by means of their acid sap, a solvent action on rocks and thus assist in their decomposition. Vegetation further contributes to the formation of soil by depositing dead leaves and stems on the surface in the form of humus, to the presence of which is largely due the black colour of garden soils.

Other important factors in the formation of soils are rivers, streams, the sea, and in some cases wind. Rivers grind down rocks and stones, and carry particles of rock or gravel to the plains or valleys, depositing them in the form of mud; this is known as *alluvial soil*, which is usually rich in plant-food. The wind occasionally adds fertile matter to soils by carrying sand, dust, straw, leaves, etc., and depositing them in hollows.

Soils are known as either (1) *transported*, when they are carried from a distance, as by any of the agencies named above; or (2) *sedentary, local,* or *indigenous*, when they remain where formed. To the latter belong the greater portion of Ceylon soils. In some cases the surface soil is transported, while the subsoil is sedentary, or *vice versa*. Transported deposits, as alluvial soils, are, as already stated, usually characterised by greater fertility than those of a sedentary nature.

COMPOSITION OF SOILS

The five main substances of which all soils may be said to be composed are:

Sand, principally composed of quartz, flint, or silica, imparts a loose porous consistency to the soil, assists air and water in finding their way through it, and helps the roots of plants to penetrate in all directions. In agricultural and horticultural practices, sand is frequently added to the soil to render it porous. (See *Manures.*)

Clay is composed of two chemical bodies, known as silica and alumina, in combination with water. When wet, it is sticky and plastic; but when burnt, as was formerly done in the cultivation of stiff soils, it loses its plastic property and becomes brittle. *Liming* also has this effect on clay soil, depriving it of its adhesive, binding nature and rendering its constituents fit for plant food (see *Indirect Fertilisers*). There are various kinds of clay, some being white, from which china-ware is made; others yellow, from which are made bricks, pots, chatties, etc.; and others are valuable in medicine. Clay is colder and retains much more moisture than sand. A certain proportion of clay is a desirable constituent in all soils, and no land can be efficiently and economically worked unless clay is present to an appreciable extent.

Lime usually occurs in soils combined with carbonic acid as a carbonate of lime in various forms, as chalk, lime-stone, and coral. It is present in large quantities in the shells of land-snails and some marine animals, besides coral. Tropical soils generally are lacking in lime, which, when present, often occurs in the form of dolomite. (See *Indirect Fertilisers.*)

Humus or vegetable mould is formed by decaying vegetable matter, such as leaves, roots, stems, etc., and exists to some extent in all cultivated soils as a dark brown substance. It often occurs abundantly on the surface of the ground in forests.

Stones are simply particles of the original rock from which the soil was formed. If they do not exist in too great a number (10% of small stones not being considered harmful) they serve a useful purpose in the soil, rendering it lighter in character, affording porosity and assisting in the retention of moisture. The stones are weathered by the atmosphere and other agencies, in the same way as the rocks from which the soil was made, so that their gradual wasting away adds material to the soil.

CLASSIFICATION OF SOILS

Soils are classed in accordance with their physical composition, thus:

Clay or argillaceous soils contain over 50% of clay. They are heavy and dense, very retentive of water, cold and difficult to work, and require to be well drained

in order to be properly cultivated. In periods of drought, plants on clay soils are apt to suffer, as the roots cannot penetrate into stiff clays, or obtain water from the subsoil. Though such soils may contain an abundance of mineral food for plants, it is often rendered unavailable by their stiff texture. This may, however, be corrected by the addition of sand, lime, or suitable manures, and by drainage. Clay soils of moderate texture have, nevertheless, very important advantages in the tropics, owing to their power of retaining soluble manures and moisture. (See *Clay.*)

Loamy soils are composed of 30 to 50% of clay, the rest consisting of vegetable mould, sand, and under 5% of lime, if any.

Sandy soils contain not less than 70% of quartz sand, have little cohesion, are very porous, and contain little nourishment for plants. Such soils can be improved by the addition of clay, marl or chalk. (See *Manures.*)

Marly soils contain from 5 to 20% of lime, and may partake of the above four characters, or of gravelly soils.

Calcareous soils contain over 20% of lime, and may partake of the characters of a loamy or sandy soil. Marly or calcareous soils rarely occur in Ceylon.

Gravelly soil is a term applied when a considerable amount of gravel or stones is present; such soil may also partake of the characters of the sandy, clay, or calcareous classes.

Volcanic soils are formed by the lava which at one time has flowed from volcanoes, and subsequently become subject to the action of the atmosphere. Soils of volcanic origin, as those of certain islands, are usually very fertile. Such soils may be said not to exist in Ceylon.

Coral soil, as found in some tropical islands, is formed by submarine growths (polyps, sea anemone, etc.), which are sedentary and have some resemblance to animals. In warm regions these have the power of extracting lime from the sea water and using it to build up in course of time reefs and atolls.

Humous soils or **vegetable mould** contain not less than 5% of humus or vegetable matter; they may in their turn partake of the character of loamy or sandy soils; or they may be composed almost entirely of decomposed vegetable matter, as in the case of peat. Humus may be said to be the most important constituent of all soils for the planter or gardener. It has a great influence on the capacity of soils for retaining moisture, renders their cultivation easier, and encourages the activity of soil bacteria. Soils deficient in humus are liable to cake and become very hard in dry weather, and quickly lose their heat in cool weather. (See *Capacity of Soils for Moisture.*)

Leaf-mould may be distinguished from humus by being composed almost entirely of decayed leaves; it is a valuable ingredient in composts for pot-plants, tender seedlings, etc. (See *Organic Manures.*)

Peat is a black soil formed by the decay of marsh plants and bog mosses, as Sphagnum moss. A black, plastic, peat-like soil occurs on mountain plains in Ceylon at elevations above 5,000 feet, usually forming a flat barren area, but it in no way forms a substitute for peat. Peat bogs are not adapted for cultivation in their natural condition, although they are a favourite resort of certain bog-plants. Rhododendrons and allied plants thrive best on well-drained peaty soils. To render peat-bogs fertile, the excess of water must be drained off, and lime and sand added. The effect of this treatment is to aerate the soil, destroy the injurious acids present, and prevent the stagnation of water.

GENERAL CHARACTERS OF SOILS

Surface-soil and subsoil are convenient terms, the former indicating the top layer of soil, which is usually distinct by its darker colour (owing to the presence of humus) and looser texture than that underneath, *i.e.* the subsoil. The latter, though usually more compact and of a lighter colour, varies considerably in character. It may consist mainly of sand, or of gravel or clay, or even resemble the surface-soil. The surface-soil varies in thickness according to locality and surrounding influences; in forests and highly cultivated lands it is usually deep, but on steep hill-sides and in dry localities it is inevitably shallow.

Heavy and light soils. Although sandy soils are heavier than clay ones, agriculturists and horticulturists call a clay soil "heavy," and a sandy soil "light." These terms, however, refer to the facility with which the soils are worked, and not to their relative weights.

Cold or warm soils. Clay soils retain much more moisture than sandy soils, and this causes a great difference in regard to their temperature. The former are therefore sometimes spoken of as *cold*, and sandy soils as *warm*. As a certain amount of warmth in the soil is necessary for plant-life, this indicates the importance of draining low-lying, cold, clay land.

Capacity of soils for moisture. This is mainly dependent on the mechanical texture or porosity of the soil material. In a soil consisting of solid particles of fairly uniform size, the interspaces are about 40% of the volume, whether the particles are large or small; but if the particles are a mixture of large and small (as gravel and sand), the volume of the interspaces is much diminished. On the other hand, if the particles themselves are porous, as in the case of loam, and especially humus, the volume of the interspaces is much increased. It is this volume of interspaces that determines the amount of water which a soil will hold when perfectly saturated, or the amount of air which it will contain when dry. The influence of humus on the capacity of a soil for holding moisture is remarkable. Schubler found that after 72 hours' exposure to moist air, humus had taken up nearly 2½ times as much water as clay, and 40 times more than sand, which, under the same circumstances, took up 16 times less than clay.

A simple way of ascertaining the power of any soil to hold water :—Fill a flower-pot nearly to the top with dry soil, and then weigh it (the weight of the pot, both wet and dry, must, of course, be known). Then gradually pour water on the soil until it begins to drop from the bottom. As soon as the dropping has ceased, weigh the whole; the difference in weight will approximately show the proportion of water held by the soil.

Capillary action of soils. The power of soils for drawing up water from the lower strata towards the surface is of the greatest importance in the cultivation of crops. It is possessed in a greater or less degree by all soils, being greater in proportion as their pores are finer. Sand possesses this power to the least extent, and fine clay to the greatest; thus a clay soil is always wetter than sandy soil under the same conditions.

There is, however, a limit to the fineness of particles which favours capillarity, and when this limit is passed, fineness is disadvantageous, since the minute particles of earth are then apt to cohere together so closely that few, if any, spaces are left between them for the admission of water. For light soils, too open a tilth is not desirable; hence the benefit of surface-rolling such soils after ploughing and harrowing. Thus, moisture is steadily sucked up from the subsoil and transmitted to the upper cultivated surface. When the surface soil is left undisturbed and becomes hard, much of its moisture passes off by evaporation. (See *Mulching.*)

The process of soil capillarity may be illustrated by taking a lump of loaf-sugar to represent the hard-caked soil. Hold one end of the lump so that it touches the surface of a cup of water, when instantly the whole lump is moistened; then take about the same quantity of granulated sugar (equalling in height the thickness of the loaf-sugar), and hold on a screen so that the lower surface of the sugar just touches the water; in this it will be found that the water rises very slowly, and not until some of the sugar is dissolved will it reach the top. King calculated that 6·24 tons of water a day evaporated from 1 acre of unstirred soil, while only 4·52 tons evaporated when the surface was broken up, raked or harrowed.

Fertility of soils largely depends, according to Liebig, "on the bulk and composition of the previous crop residues, and the extent to which these have been subsequently destroyed." Therefore the crop which leaves behind the largest amount of roots, leaves, etc. will best maintain or increase the organic capital of the soil. Soil fertility may be summarised as being dependent on the following conditions, viz.:

(1) Sufficiency of available plant-food; (2) suitable texture or mechanical state of the soil; (3) absence of injurious compounds; (4) a healthy percolative subsoil; (5) sufficiency of moisture; (6) suitable temperature. The absence of any of these conditions will render a soil proportionately infertile. Agricultural chemists distinguish between *fertility analyses* and *complete analyses*, the latter indicating only the amount of plant-food present in the soil, and the former the proportions *available* to the crop—a very different thing.

Sterilisation of soils. Experiments have shown that sterilising the

ground by intense heat restores soil fertility by destroying injurious protozoa, which exist in the soil and prey on the useful soil bacteria engaged in the work of fixing nitrogen from the atmosphere into a form suitable for plant-life. This may partly account for the fact that in the tropics, after a period of very dry weather the soil often shows signs of extraordinary fertility. Similarly, soils which have become exhausted by intensive culture may be largely restored to fertility, in addition to killing off eelworms and other injurious insects present, by heating artificially to a temperature of about 140° F.

Exhaustion of soils. The term is based on money values, and has no precise definition. Although no soil can be entirely exhausted, generally speaking it becomes so, as regards any particular crop, whenever the cost of cultivation comes to as much as the crop is worth.

Thus the word " exhaustion " refers to the available character of the plant-food present in the soil. Most cultivated soils contain a store of plant-food which it would take many crops to exhaust; but a large proportion of this may be present in such a form that plants are unable to make use of it. Thus an acre of land may contain several thousand pounds of phosphoric acid, potash, or nitrogen, and yet be in " poor condition." (See *Fertility of Soils*, above.)

Theory of toxic substances in the soil. It is sometimes supposed that infertility in a soil may sometimes be due to " sickness " or the presence of compounds injurious to plant-growth, rather than to insufficiency of plant-food. Such compounds are attributed to decomposition products of plant-tissue, excretions from growing roots and germinating seeds, etc. It is thus supposed that certain crops may form toxic substances in the soil which are deleterious to the crop following. Excessive organic matter in the soil, as in a long-cultivated and much-manured vegetable garden, is also considered capable of producing similar toxic effects. The proper corrective for such a condition is suitable crop-rotation (which see), a liberal application of lime and of a suitable fertiliser.

EXAMINATION OF SOILS

To ascertain approximately the composition of a given soil: Weigh out ¼ lb. of earth after it has been well dried, boil it for a short time in a pint of water, and then pour all into a glass vessel. Into this insert a piece of **blue litmus paper**; if this turns to a red colour, it shows that acid humus is present and that lime is necessary to counteract the acidity. Then add more water, stir well, and pour off carefully the muddy water into a large vessel, care being taken that none of the sand which settles to the bottom is lost; stir up the sand with fresh water, which is again poured off into the larger vessel. This is to be done several times until the sand becomes clean and free from mud. The contents of the larger vessel are to be allowed to remain for several hours until the fine mud settles to the bottom, when the clear water is to be carefully poured off. The sand and the mud should then be dried and weighed separately, when, by comparing their bulk or weight, the proportion of sand and earthy matter in the soil can be ascertained.

The presence or absence of lime in a soil. Besides the blue litmus paper test for lime already described, the presence of lime may be ascertained thus: Take some 10 or more small samples from different parts of the ground, mix them well together; then place a small sample in a tumbler, and pour on it a wine-glassful of muriatic (hydrochloric) acid. If the liquid fizzes and bubbles freely, the soil may be considered to contain a sufficiency of lime; but if it only effervesces feebly, it is safe to conclude that a dressing of lime is desirable.

To ascertain proportion of humus in the soil, heat for an hour to a red heat a given weight of thoroughly dry earth in an iron or clay vessel; the soil rapidly blackens if much humus is present, and then turns red or yellow, the vegetable matter being burnt off; when cool, weigh the earth again, and the loss in weight will give the proportion of humus in the soil.

Method of taking soil samples for analysis. After clearing the surface of the ground of leaves and twigs at any selected spot, dig a small square hole 18 in. to 2 ft. deep, removing all the soil. Then cut a thin section from top to bottom of one side of the hole, and collect this in a clean box or sack. Repeat this operation in five or six other spots where the soil is uniform in appearance, and thoroughly mix the samples so obtained. From the mixture take sufficient soil to fill a box 6 in. by 4 in. by 4 in., and label the box with name or number of plot or field. Particulars as to elevation, rainfall, crop growing or to be grown, and previous manuring (if any) should be sent with each sample.

CEYLON SOILS

These as a rule are poor and shallow, and their character in general, being typical of many other tropical countries, may be summed up thus:

(1) *Sea Coast*: soils loose and gravelly or sandy, often with a large proportion of laterite (cabook), usually of a deep reddish colour, in some localities a deposit of white silvery sand occurring on the surface; in such soils, however, Cinnamon, Coconut palm and certain other crops flourish, provided the rainfall is sufficient. (2) *Inland*, up to medium elevations in Southern and Central Provinces: soils of a reddish clay, often with a large proportion of laterite and a small percentage of humus. (3) *Up-country*: soils occasionally of a loamy character but usually lacking in fibre and deficient in lime; black peaty clays occur in valleys or swamps at the higher elevations. (4) *North-Central Province*: soil variable, in some places hard and poor; in others deep and black, free from stones and easily worked. (5) *Jaffna Peninsula*: soil generally of a hard clayey nature.

Patana soils. These and similar soils in an inert condition should, when brought under cultivation, be thoroughly drained and deeply dug, the surface grass, leaves, etc., being burnt on the ground; well-decayed manure, basic slag and air-slaked lime (say ½ lb. of each per sq. yd.) should be spread on the surface and well forked in.

CHAPTER II

PLANT LIFE

Most plants consist of *shoot* and *root* systems, the former ascending, seeking the light, bearing branches, leaves, flowers, and fruits; the latter descending and avoiding the light. The point from which the two diverge is popularly known as the "collar." Some plants have one or more of these parts wanting, but it is unnecessary to consider these here.

The Roots (descending axis) fix the plant in the soil; they absorb nutriment in a fluid state from the latter, and in many cases act as reservoirs of food (starch) for the growth of a succeeding season, *e.g.* Yams, Sweet-potato, Arrowroot and other tuberous-rooted plants. To enable the roots to penetrate the soil without injury, their delicate tips are protected by *root-caps*. In most plants these are very minute, but in some they are large and plainly seen; in the thick, hanging, *aerial roots* of Screw-pines (Pandanus) the root-caps are very large, and can be pulled off by hand. Towards the ends of the roots *root-hairs* are produced; these apply themselves to particles of the soil, and by means of the acid fluid permeating their thin cell walls they dissolve certain salts, which they absorb and use in the nourishment of the plant.

The Shoot or Stem (ascending axis), generally rising above the surface of the ground, exposes the leaves and other appendages to the full influence of light and air, conducts the necessary mineral substances from the roots to the leaves, and acts as channels of food supply from the latter. Stems are *erect* (as in trees), *climbing* by hooked spines (as in Calamus), or by tendrils (as in Bignonia and Vitis), *twining* (as in Ipomoea), *creeping* (as in Sweet-potato, Pepper, Vanilla, etc.), or *underground* (as in Ginger). Underground stems (*rhizomes*) superficially resemble roots, but can be distinguished by their possessing leaves in the form of scales with buds (rudimentary shoots) in their axils. Ordinary stems are of two types, *dicotyledons* and *monocotyledons*, sometimes known as *exogens* and *endogens* respectively. The former represent the majority of trees, shrubs and annual plants, in the young stem or shoot of which there is a soft central cylinder of pith, surrounded completely by wood, and external to this by *cortex* and afterwards *bark*, which is formed by the dried-up and dead cortex cells. The stems of grasses are known as *culms*, those of herbaceous plants as *haulms*, whilst those of orchids are commonly referred to as *pseudo-bulbs*.

The cortex is separated from the wood by a fibrous layer or *bast*, on the inner side of which is a thin, watery or viscid layer called the *cambium* or formative tissue. In plants of this type which exist for more than two years, new layers of wood and cortex (*wood* on the inner side and *cortex* on the outer) are successively formed from the cambium. In the second type of stem (monocotyledon), as occurs in palms, bamboos, etc.,

the wood and bast are scattered throughout in strands (*vascular bundles*), instead of being continuous and solid; there is no separable bark, this being represented by a hard external layer called the *rind*; in these the stem is hardest externally, whilst in the former type the hardest part of an old stem is internal, *i.e.* the heartwood; there is no cambium ring, therefore the stem does not normally increase in thickness when once formed.

The Leaves are usually composed of a thin layer of green tissue (*mesophyll*), which contains the *chlorophyll* bodies or green colouring matter. This is held together by a framework of ribs commonly known as *veins* (i.e. *vascular bundles*). Each surface is protected by a special layer of cells, the *epidermis*. In the under surface of ordinary leaves are microscopic openings (*stomata*), leading into the tissue of the leaf; through these the inhalation and expulsion of air and moisture take place. In a few exceptions the leaves are placed edgewise towards the source of light, as those of Eucalyptus, Loranthus, etc., the stomata in these being equally distributed over both surfaces of the leaf; in floating leaves, as in Nymphaea, the stomata are on the upper surface.

The functions of leaves may be compared to those of the stomach and lungs of animals. The roots, stems and leaves, being concerned in the supply and elaboration of food, are called *organs of nutrition*, whilst the flowers are termed the *organs of reproduction*, normally producing fruits and seeds.

Flowers. A typical flower consists of four distinct series or circles of parts, the outer of which, composed of small, green leaf-like organs (*sepals*), forms the *calyx*; the next inwards, a circle of usually brightly coloured and sometimes scented leaves, called *petals*, forms the *corolla*; when both sepals and petals are similar in form and colour, as in Lilies, they are known collectively as the *perianth*; this term is also sometimes used when one of the circles is absent, as in *Euphorbiaceae*. The third series, consisting as a rule of a few or many thin stalks, bearing swollen bodies at their tips, are the *stamens* or male organs; the stalks are known as the *filaments*, and the swollen bodies as the *anthers*, which usually contain a powdery substance called the *pollen*. The fourth and innermost circle consists of the *pistil*, the lower inflated part of which is the *ovary*, containing the *ovules*, which when fertilised by the pollen become the *seeds*. At or near the apex of the pistil is the *stigma*, through which the pollen tubes (grown from the pollen grains) penetrate to fertilise the ovules. The intervening part, when present, between stigma and ovary is called the *style*.

Flowers are *pollinated* when the pollen from the anthers is transmitted, either naturally or artificially, to the stigma. The act of *fertilisation* is brought about by one (or more) of the pollen grains developing a tube which grows through the stigma, down the style, to one of the ovules, when its contents fuse with a special cell of the latter and form the *embryo*. (See *Plant Breeding*.)

The functions of the exterior circles, calyx and corolla, may be considered as protective and attractive, respectively (or collectively), while the stamens and ovary are concerned with reproduction. These latter may be present in the same flower (*hermaphrodite*), or they may exist in separate flowers (*unisexual*). Flowers which possess stamens and not a pistil are called *staminate* or *male* flowers; *female* or *pistillate* flowers are those in which the stamens are absent. Some plants bear both kinds of flower on the same individual, and are called *monoecious*; others bear them on separate individuals, *e.g.* Palmyra and Date palms, and are known as *dioecious*.

Seeds. Every perfect seed contains an *embryo*, which is the future plant in a rudimentary state. In some cases, as in *Leguminosae*, it is large and fills the seed. If the shell be taken off a bean seed, for example, the following parts can be easily distinguished :—

(1) Two fleshy bodies placed face to face, called *cotyledons* or seed-leaves, known also as "nursing leaves"; (2) a minute projection at their base pointing upwards, called the *plumule* or future shoot; (3) a longer projection, also at their base but pointing downwards, called the *radicle* or future root. In germination the radicle grows downwards, the *cotyledons* separate, and the plumule develops upwards, the whole seedling living and increasing on the reserve food stored in the nursing leaves, until the roots are functionally active and the young parts and leaves above ground assume their green colour. In other seeds, as cereals, palms, grasses, etc., the whole embryo is very small and surrounded by a mass of tissue (*endosperm*), which may be either of a mealy consistency (as in Maize), oily (as in Hevea), or horny (as in Palms). In these cases the endosperm, and not the cotyledons, provides the requisite nutrition for the young plant. In some cases, as often in Mango, Citrus, and Eugenia, the seed contains several embryos (*polyembryonic*). These usually arise as buds from the *nucellar* tissue and are analogous to vegetative buds. (See *Germination of Seeds.*)

NUTRITION OF PLANTS

In the youngest stages of its life, as has just been shown, the plant is supplied with nourishment from the food stored up in the seed for that purpose. By the time the roots and leaves have been formed, this supply becomes exhausted, and the plant must now obtain its food from the soil and the air. Through their delicate root-hairs the roots absorb from the soil various chemical salts in solution, which are transmitted upwards through the stem and distributed to the leaves. The acid sap of the root, together with the CO_2 gas (carbon dioxide), probably assists the moisture in dissolving the mineral matter in the soil. The leaves imbibe from the atmosphere, through their stomata (*respiration* process), carbon dioxide, the carbon of which enters into combination with the substances absorbed by the roots to form sugar and then starch, and also albumen matter.

The process of forming starch by the agency of ***chlorophyll*** (the green colouring matter in the leaves and green parts of plants) is called *assimilation* or, to use the more modern term, *photosynthesis*. This can only take place under the influences of light and air, the latter supplying the CO_2 and the former the energy by which the carbon is split from it. During sunlight the stomata of the leaves are continually giving off oxygen which has been separated from the CO_2 taken in, the carbon itself being retained by the leaf. In darkness no fixation of carbon can take place, as light is necessary for the splitting of the CO_2, so no starch is formed and at the same time no oxygen is evolved. Consequently the process of respiration, which is always going on, becomes evident through the evolution of CO_2. In sunlight this is masked as the CO_2 formed in the leaf by respiration is immediately concerned in assimilation.

As the saline matter is carried up from the soil through the plant in extreme dilution, the excess of water thus absorbed has to be got rid of in the leaf. This passes out through the stomata in the form of water vapour, and the process is known as *transpiration*. It is important therefore to distinguish clearly between the three processes of *assimilation, respiration,* and *transpiration.*

Food of Plants. The main elements necessary in the food of plants may be said to be hydrogen, oxygen, carbon, nitrogen, sulphur, phosphorus, potassium, magnesium, calcium and iron. The supply of the first three elements comes from the air and water, the remainder are taken up in the form of salts from the soil. The last three, though often found in the ash of plants, are not considered essential ingredients in their food. Nitrogen is of the greatest importance, being an essential constituent of every living body. It constitutes $\frac{4}{5}$ of the atmosphere,

but plants (other than leguminous species) are unable to assimilate it in a free state, that is, unless it is chemically combined with another element. Plants absorb their nitrogen from the soil in the form of nitrate or ammonia compound. Besides nitrogen, the other elements likely to be deficient in the soil are phosphorus and potassium. These are often supplied in the form of phosphates and potash salts. See *Fertilisers*.

Soil Bacteria and Nitrification. The appropriation of nitrogen by plants is due to the agency of bacteria, which exist in all fertile soils. These microscopic organisms, or ferments as they are called, perform the usual function of converting the nitrogenous organic matter in the soil into *nitrates*, or soluble plant-food. The process is accomplished by the action of two separate groups of bacteria, and is termed *nitrification*; one group converts ammonia into *nitrites*, and the other changes nitrites into *nitrates*. A favourable degree of warmth and moisture is essential to the active operations of these bacteria; at low temperatures their work is retarded, and at a certain degree of coldness it practically ceases. Hence an open porous soil, assisted by good tillage and mulching, encourages their activity and thereby tends to promote oxidation of the organic matter in the soil.

Nitrogen-collecting Bacteria. It is well known that on the roots of certain leguminous plants there usually occur nodules or tubercles which vary in size from that of a pin's head to that of a pea. These nodules contain bacteria which abstract and fix the free nitrogen of the air. The nitrogen thus becomes stored up in a combined form in the roots and stems of such plants, and when the roots of these are left in the ground, or the whole crop is dug in as green-manure, the soil is considerably enriched with nitrogen. Only leguminous plants (chiefly those of the sub-tribe *Papilionaceae*) obtain their nitrogen in this way, all other plants, so far as is known at present, depending for their supply on nitrates formed by the soil bacteria from organic substances in the soil. The effect of this property of leguminous plants has long been recognised in agriculture, and crops of this family are therefore esteemed an important factor in the rotation of crops, and also in what is known as green-manuring, which see.

Nitro-bacterine, Nitragin, or Bacteria Culture. The nitrogen-gathering bacteria of *Leguminosae* having been isolated, cultures of them have been placed on the market in commercial forms under such names as the above, it being claimed that these benefit certain crops growing in soils which are deficient in the right kind of bacteria. These cultures are applied by means of inoculating the seed before sowing, or the soil by watering through a rose, with a solution containing the desired germ. So far, however, the advantages claimed for these cultures and their artificial application do not appear to have greatly materialised.

Water in relation to Plant-food. Water is an essential factor in the life of a plant; it enters very largely into its composition, enabling it to retain rigidity and carrying nutritive substances in solution through the plant's system. It constitutes by far the greater bulk of fresh fruit and vegetables (at least 80%), and also forms a large percentage of ordinary cultivated soils. The solution of mineral substances and gases in the soil, for absorption by roots as plant-food, is dependent on the presence of water. When the amount of water at the root is deficient, the plant wilts and, unless a timely supply is restored, withers and dies.

Water varies in several respects according as it is obtained from rain, ponds, streams, springs, or wells. Rain-water is free from mineral matter and usually contains a small percentage of ammonia, which it obtains from the atmosphere; it also contains some carbon dioxide gas, so that when it reaches the ground it is able to dissolve a certain amount of carbonate of lime in the soil. Rain-water is thus

said to be " soft," and is preferred for watering plants or crops. Spring or well-water usually contains varying quantities of carbonate of lime and other mineral matter, when it is said to be " hard " ; in some cases it also contains large quantities of iron oxides, and these form encrustations on bodies which come in contact with it. This is often characteristic of well-water in the northern part of Ceylon, which consequently is injurious in that condition to plant or animal life. Such water should always be exposed for some time to the sun before use. Irrigation waters, however, if they move rapidly through the soil are liable to remove large quantities of nitrogen (in the form of nitrates) and other valuable ingredients from the soil.

COLORATION OF LEAVES, FLOWERS, ETC.

*Colours in leaves, flowers and fruits are due to the presence of certain pigments which arise mainly through the direct influence of sunlight. The greenness of leaves is due to the presence of the pigment *chlorophyll.* Accompanying it are two yellow colouring matters (*carotin* and *xanthophyll*), chemically akin. As a rule, before a leaf is shed the chlorophyll disappears, leaving behind the yellow pigments, which give rise to the autumnal golden tints of temperate climes.

The above pigments are closely associated with the protoplasm of the leaf-cell. Other pigments known as *anthocyanins* occur dissolved in the cell-sap, colouring this as a rule. This term literally means " blue flower." The more appropriate one, *erythrophyll*, signifying " red leaf," was formerly applied to these pigments. Pink and blue flowers, as well as those of intermediate shades, and red leaves, all owe their coloration to this class of pigment. According as the cell-sap is acid or neutral, so the pigment reveals itself in the red or blue respectively. As the sap is usually acid, reds of various shades predominate in the plant world. When *anthocyanin* develops in a leaf prior to its fall, the effect, in combination with the yellow pigments, is to create bright orange-red foliage, a pleasing addition to the commoner yellow autumn leaves.

Anthocyanin may appear temporarily in the young leaves, and, if abundant before the chlorophyll is largely developed, a bright red immature foliage results. This is very evident in many tropical trees, *e.g.* Mesua ferrea (Ironwood Tree of Ceylon), species of Calophyllum (Keena), Eugenia, Cinnamomum, etc. The coloration is at times so vivid that from a distance such trees appear to be in flower. Very occasionally the young foliage is of a bluish rather than of a reddish hue, hence even the blue of the flower, like the other floral colours, may be foreshadowed in the foliage leaf.

In the wild state, in temperate countries, the *anthocyanin* rarely persists in the leaf, but examples of such are abundant in tropical floras. For example, brightly coloured foliage is a feature of species of Coleus, Acalypha, Cordyline, Codiaeum and Caladium. Selected horticultural varieties of these are sometimes preferred for colour-effect in tropical gardens to flowering plants, whose sombre greenness is, as a rule, enlivened by floral colouring only for a brief period of the year.

Flowers which are pollinated by insects are usually brightly coloured, while wind-pollinated flowers are generally inconspicuous. In those flowers which depend upon insect agency for cross-pollination the greenness has been eliminated from the floral leaves (petals), and other pigments substituted in order to render the flowers conspicuous to insects amid the green foliage. It may be assumed that if cross-pollination through insect agency had not arisen in the course of plant evolution we should have had no brightly coloured flowers. In bright yellow flowers the protoplasmic pigments predominate. When only sap pigments (*anthocyanins*) are present, the flowers range from pink to blue—the latter being the

* John Parkin, M.A., in the *Quarterly Journal of Forestry*, October, 1919, and January, 1920.

most advanced floral colour, beloved of bees. Pale yellow flowers also owe their delicate coloration to a sap-pigment, a form of anthocyanin.

Our gorgeous orange and scarlet flowers result from the occurrence together of both yellow protoplasmic and pink sap pigments. A complete elimination of all pigments results in white flowers, which in nature are generally visited, and so pollinated, by night-flying insects. The lack of pigment makes such flowers visible in the semi-darkness. A similar range of colouring occurs in fruits as in flowers. As the green of the ripening fruit disappears, either yellow, red, purple or occasionally blue takes its place. Very rarely all pigments may disappear, leaving a white fruit, *e.g.* varieties of *Eugenia malaccensis* and *Solanum melongena*. Here again, as in flowers, the vivid coloration of fruits is generally for a definite purpose, viz. to attract birds or animals for the sake of seed-distribution. Dry fruits distributed by the wind or those which scatter their seeds by explosive mechanism are not, as a rule, brightly coloured. Brightly coloured seeds are also commonly met with in the tropics. (See *Ornamental Seeds.*)

CHAPTER III

MANURES

THE use of manures is, briefly, to supply plant-food to the soil to enable plants to make the maximum growth or produce the best crops. They restore the fertility of an exhausted soil and enrich a naturally poor soil. Any substance, therefore, added to the soil which has the power, directly or indirectly, of increasing its fertility may be regarded as a manure. It may contribute directly by supplying plant-food, or indirectly by (*a*) reacting chemically or bacteriologically on substances already present in the soil but not in a form capable of being absorbed by plants; (*b*) by improving the mechanical condition of the soil, thus rendering it more penetrable to the roots of growing crops.

Growth in plants cannot take place without the main elements of which they are composed being extracted from the soil, and it is evident that if no means be taken to restore these the soil gradually becomes "exhausted" (see *Soils*). According to Liebig, "the best fertiliser for any particular crop is that which contains the same amounts of nitrogen, phosphoric acid, potash, etc., as are removed from the soil by a typical good yield of the crop in question."

Manures may be divided into two main classes, viz. (1) *Organic* or *natural* manures, as those composed of the remains of vegetable or animal substances; (2) *Inorganic* or *artificial* manures, which are of mineral or chemical origin. To these may be added a third, viz. *Indirect* fertilisers, including lime, gypsum, marl, charcoal, etc., which are of value chiefly for liberating plant-food present in the soil but not in forms available to plants.

ORGANIC OR NATURAL MANURES

Cattle, Pen or Natural manure. By this is generally understood the manure produced by horses, cattle, or other animals. The excrements of different animals possess different manurial properties, but for ordinary purposes general farmyard manures are best mixed together, both solid and liquid. They should be stored in a pit, preferably under cover, provided with a drain-pipe at the bottom or other means with which to drain off excess of liquid, if necessary. Any litter available, as grass mowings, leaves, etc., should be mixed with the solids, and the whole kept moist by throwing the liquid portion over the heap occasionally. If left to become very dry the manure will lose much of its value.

Pen manure deteriorates by excessive heating, but partial decomposition by slight fermentation is essential in order to render its constituents more soluble. It may be even injurious if applied in a fresh state, affecting both the crops and the nitrates of the soil. The chief value of natural manure is its aerating effects on soils, increasing their water-holding capacity; but it also contains all the essential elements of plant-food. It restores humus to the soil, gives cohesion to sandy soils and renders them more resistant to drought, whilst it renders clay soils more porous and workable. A ton of average well-rotted cattle manure, it is estimated, contains 10 lb. each of nitrogen and potash and 6 to 7 lb. phos. acid. 8 to 10 tons of such manure per acre may be considered a good dressing.

Stable or horse manure is called a "hot" manure, because, owing to its loose texture, it rapidly undergoes decomposition or fermentation, producing a high degree of heat. On this account it is very liable to lose much of its nitrogen in the form of ammonia. It is usually richer than cattle manure, but is more liable to loss by keeping.

Goats' dung is sometimes procurable in the neighbourhood of coolie lines. It is a good manure, though its action seems to be comparatively slow. Firminger, in India, stated: "I have often used it, but not with any marked advantage. Sheep's dung, being similar, would probably give like results."

Poultry dung is somewhat similar to guano, though less valuable than that material, weight for weight. The difference in quality is largely due to the fact that the food of fowls is very different from the fish diet of the sea-birds which produce guano. Fowl manure usually contains about 2 to 4% of nitrogen, while good Peruvian guano may contain as much as 20%.

Night-soil. The supposed high fertilising value of this is probably much overrated. The late Dr. Bonavia, of Lucknow, considered that it produced special "richness of colour in flowers, and vigour and succulence in vegetables," a statement which presumably lacks confirmation. On the continent of Europe and in some other countries night-soil is sometimes valued as a manure, being made up in a special form for transport. It has, however, considerable disadvantages, more especially in the tropics, where its use is not to be recommended.

Poudrette. In some large European and American towns, night-soil is dried and made into a form convenient for transport and sold under the name of poudrette; but as it is prepared by adding large proportions of such materials as gypsum, ashes, earth, sawdust, etc., the mixture is considered to form but a poor manure.

Blood meal is an excellent manure, being rich in nitrogen (10 to 12%) in an active state. It may be applied to general field crops at the rate of about 200 lb. per acre. It is, however, an expensive source of nitrogen compared with nitrogenous fertilisers, such as sulphate of ammonia, nitrate of soda, etc., and its nitrogen is not so readily available as in these.

Bones are rich in phosphoric acid and lime and are often used as a manure for field and garden crops. When in merely a crushed state their decomposition is slow, consequently their fertilising properties are more lasting; when steamed (to remove fat, etc.) and reduced to a powder or meal, they should contain not less than 3½% nitrogen and 23% phosphoric acid. The usual commercial forms in which bones are supplied are: ¼ inch bones, bone-meal, and bone-dust. Bones are especially beneficial when used on soils deficient in lime; they are commonly used on rice-fields in Ceylon and give good results. Soils rich in decomposing organic matter, as leaf-mould, are greatly enhanced in fertility by an application of bone-meal.

Guano. This valuable manure originally consisted of the dried excrements and waste of sea-birds which had accumulated throughout ages on the coast and islands in the rainless tracts in the Peruvian and Chilean seaboards.

These original guanos were rich in nitrogen and phosphate, the best known being obtained from the Chincha Islands, and contained 14% nitrogen, 12 to 14% phosphoric acid, and 2 to 3% potash. Similar deposits were also found in rainless tracts and, being less rich in nitrogen, were known as phosphatic guanos. The supply from these and other sources has now become practically exhausted.

Modern guanos vary greatly in their plant-food content, and the price varies accordingly. The guanos of commerce may be classified under two heads: (1) *Nitrogenous guano*, of which the "Peruvian" was the original type, containing 4 to 7% nitrogen and about 30% phosphate; (2) *Phosphatic guano*, of which the "Bolivian" was the original example, containing only about 1 to 3% nitrogen and 30 to 50% phosphoric acid. *Fortified* or *Equalised guano* is formed by adding sulphate of ammonia and potash to phosphatic guano.

The requisite application of guano depends on its constituents. As a source of phosphoric acid, a guano containing 1 to 3% nitrogen and 30

to 50% phosphoric acid, 1 cwt. per acre would be an average dressing. For gardens, it may be applied in solution at the rate of 2 oz. to the sq. yard, either dry or dissolved in water.

Fish guano. Dried and powdered fish refuse is a valuable fertiliser, a good sample of which may contain from 10% nitrogen, 25% phos. acid, and 12% sulphate of potash. It is used with good effect for tea, coconuts and other crops, being rapid in decomposition. It should not be used on land above any source of water-supply, as by polluting the latter it has been known to be a cause of dysentery, etc.

Leaf-mould. Leaves, when thoroughly decayed and reduced to a state of mould, form a sort of manure known as leaf-mould. This is usually rich in potash and nitrogen and is a most valuable growing medium, either alone or mixed with loam, being especially suited to the growth of tender plants and seedlings. All fallen leaves and vegetable refuse in a garden should therefore be collected and thrown into a deep pit or trench, dug in some obscure corner, in order to provide leaf-mould. In dry weather, the leaves should be kept in a moist state so as to hasten decomposition. Leaf-mould is particularly suitable for the cultivation of ferns and such plants as naturally grow under shade in the jungle. (See *Soils.*)

Castor-, Ground-nut, or Poonac-cake, etc. are the residues of castor-oil seeds, ground-nuts, copra, etc. after the oil has been extracted. They are esteemed as manures, being usually rapid in action, and are somewhat largely used on up-country tea estates in Ceylon. Bamber considered castor-cake to be especially beneficial to tea crops, the percentage of nitrogen in the best quality being about 6%, though often only 4 or 5% in some grades. Rape- and cotton-seed cakes are also valuable manures, but contain less nitrogen than castor-cake.

Jadoo, or Jadoo-fibre. This potting material or growing medium was patented some years ago in England. It has for its foundation peat-moss of an exceedingly spongy and absorbing character, not unlike fine coconut fibre in appearance. This is said to be boiled, impregnated with nitrate of potash, bone meal, gypsum, etc. and then fermented. It is especially adapted for such plants as are required for growing indoors, being clean and light to handle. The cost of transport has prevented its becoming popular in the tropics.

Humogen. A preparation of peat similar to the former, for which a high manurial action has been claimed. It is said to be prepared by "neutralising the peat and then causing it to undergo decomposition up to a certain point, after which the mass is sterilised and inoculated with a culture of nitro-fixing organisms."

Seaweed (Kelp) is commonly used as manure where it can be cheaply transported, near the sea, being applied in the fresh state either for digging into the ground or for forming a mulch on the surface. The percentage of manurial ingredients, however, which sea-weeds contain is small, and their effect on soils is not lasting. During the War they were employed fairly extensively in localities near the sea as a source of potash, being applied to the land in a dried powdered form; or they were burned, and the ash was then marketed or applied to the land. Sea-weeds are also rich in iodine. (See *Jaffna moss* and *Agar-agar.*)

Town-sweepings may sometimes form a kind of manure, though often they consist largely of sand and are of little value. The refuse from the neighbourhood of markets may be of some manurial value, while scrapings from side-drains often contain a certain amount of humus, but their liability to contain seeds of troublesome weeds is an objection to their use on crops.

Coir-dust decomposes so slowly that it can hardly be said to be of much value as a manure. It has, however, a beneficial mechanical effect on certain soils, especially such as are deficient in humus, and may with advantage be used to give "body" to potting soils, but it should always be well leached in the open air and rain before use. In the neighbourhood of Colombo and coast towns generally, it is commonly employed for pot-plants. (See *Potting Soils.*)

Woollen refuse, shoddy, hoof and horn meal, etc. Waste materials from woollen and cloth mills, horn shavings, etc., are used in Europe to some extent in the manufacture of manures. They usually contain from 5 to 10% or more of nitrogen, and their manurial effects extend over two or three years.

INORGANIC MANURES OR FERTILISERS

These are more commonly referred to as *artificial* or *chemical* fertilisers. They may be classified into :—

(1) *Nitrogenous fertilisers,* such as Sulphate of ammonia, Nitrate of soda, Calcium cyanamide, etc.
(2) *Phosphatic fertilisers,* such as Superphosphate, Basic slag, Ground mineral-phosphate, etc.
(3) *Potassic fertilisers,* such as Sulphate of potash, Muriate of potash, Kainit, etc.
(4) Compound fertilisers containing two or more of the four principal plant foods, *e.g.* Nitrate of potash, Nicifos, Ammophos, etc.
(5) Calcareous or indirect fertilisers, such as lime, chalk, gypsum, etc.

Nitrogenous Fertilisers, as the name denotes, contain nitrogen. The latter may be in the immediately available or nitrate form, where the nitrogen does not require to undergo any change in the soil before plants can absorb it, or in the non-available form, where it has to undergo chemical and bacteriological changes in the soil before it is converted into the nitrate form and thus rendered soluble and available as plant-food.

Sulphate of Ammonia, obtained synthetically, also as a by-product in the manufacture of coke from coal, is probably the commonest and cheapest source of nitrogen. It is in the form of greyish-white powder, and contains 20 to 21% nitrogen in the form of ammonia. This nitrogen is not soluble and immediately available to plants, as is the nitrogen in nitrate of soda, but has to be converted in the soil by chemical and bacterial action into nitrate nitrogen before plants can absorb it. This reaction is much more rapid in the tropics than in the temperate zones. Since it is a physiologically acid fertiliser, its continued use over a number of years in soils poor in lime tends gradually to exhaust them of lime, and to render them acid and unhealthy for normal plant growth. It should therefore be replaced every two or three years by nitrate of soda or calcium cyanamide, or the land should receive periodical dressings of lime to neutralise the acidity which it tends to produce. This property is sometimes rather an advantage, as, for example, in tea soils, because tea and certain other crops appear to prefer an acid soil. An average application is 1½ to 2 cwt. per acre for field crops, but it is frequently used as a source of nitrogen in "complete" mixtures. For the garden, it may be applied at the rate of 1 to 1½ oz. per square yard, or the same quantity dissolved in 1 to 2 gall. water. To apply this evenly in a dry state, it should be mixed with some fine sand or finely sifted soil. (See *Lawns.*)

Nitrate of Soda contains its nitrogen in the soluble and immediately available nitrate form. It does not, therefore, have to undergo any change in the soil before plants can assimilate it. Its action on crops is very rapid and its effect has been observed 24 to 48 hours after application. It is therefore often used as top-dressing for backward crops and in late seasons. Nitrate of soda was originally found as a deposit in the rainless desert tracts of Chile, and this form is still largely used in agriculture. It is now manufactured synthetically with a slightly higher nitrogen content, and is somewhat cheaper than Chilean nitrate. The latter, formerly known as "Chile saltpetre," contains 15 to 16% nitrate-nitrogen.

Being readily soluble in water, this fertiliser is easily washed out of the soil by heavy rain or repeated heavy waterings, and therefore several small dressings are preferable to one large dressing. Applied in large quantities over a period of years it tends to deflocculate heavy clay soils and render them sticky, intractable and difficult to work. It does not produce soil acidity as does sulphate of ammonia. In recent years it has been replaced somewhat by the latter, which is cheaper. An average dressing is 1 to 2 cwt. per acre, and for gardens it may be used at the rate of ½ to 1 oz. per square yard; or the same quantity may be dissolved in 1–2 gall. water and applied with a watering-can and rose. It is computed that 100 lb. of nitrate of soda contain as much nitrogen as about 1¾ tons cattle manure in the tropics.

Nitrate of Lime, or Calcium nitrate, a nitrogenous fertiliser containing 15·5% nitrogen in the immediately available nitrate form, and 28% of lime. It is produced synthetically in Norway, and is supplied in the form of a white granular salt. It is very deliquescent and rapidly absorbs moisture from the atmosphere to become moist and sticky. This disadvantage has now been overcome by mixing with it 5% ammonium nitrate, which also enriches it. As a source of nitrate-nitrogen, it is equal in its manurial effects to that of nitrate of soda, and is therefore frequently used in temperate climates as a top-dressing. It is a valuable fertiliser for soils deficient in lime, and it has no secondary effects on the soil as have sulphate of ammonia and nitrate of soda.

Calcium Cyanamide, or *Nitrolim,* is a fine black powder containing 20% nitrogen

in the cyanamide form and 22% caustic lime. It is produced by heating chalk and coke in an electric furnace to form calcium-carbide, which is finely ground and then heated; nitrogen gas, obtained by passing air over heated copper, is then passed through it to form calcium cyanamide. The nitrogen in this fertiliser has to undergo certain changes in the soil before it eventually becomes converted to the nitrate form and, as such, soluble and available as plant-food. It is a useful fertiliser in soils deficient in lime, but is not suitable as a top-dressing, and when applied to the soil it should be immediately forked in, otherwise loss of ammonia by volatilisation is liable to occur. On this account it is marketed in drums. It should not be mixed with superphosphate and in the case of annual crops it should be applied 2 or 3 weeks before sowing seed.

Urea is a concentrated white crystalline substance produced synthetically by bringing together pure ammonia and carbon dioxide under very high pressure, and contains 46% nitrogen. When applied to the soil it is rapidly converted to ammonium carbonate, and finally to a nitrate. Since it is not very soluble, it is not advisable to use it as a top-dressing. In its effect it has the same value as sulphate of ammonia, except that it is richer in nitrogen. It should not be mixed with superphosphate, and for the tropics it has the disadvantage of being deliquescent in moist warm climates.

Ammonium Nitrate is probably the quickest acting of the nitrogenous fertilisers. In its pure form it contains 35% of nitrogen, half in the nitrate form and the other half as ammonia. It is a deliquescent substance, but its greatest disadvantage is that it is liable to explode if stored in large quantities.

Phosphatic Fertilisers are valued for their phosphoric acid (P_2O_5) content. Broken bones was the first phosphatic fertiliser used, but later the manufacture of superphosphate was discovered by Lawes at Rothamsted, and at the present time there is quite a number of forms of this fertiliser on the market. Their phosphoric acid may be either in the water soluble form, as in superphosphate, or in the insoluble form, *e.g.* ground mineral phosphate. The former is the more valuable because, being soluble, it is more readily available and evenly disseminated throughout the soil.

Superphosphate is a fine yellowish-white powder produced by the action of equal weights of ground mineral phosphate and sulphuric acid. The resulting mixture contains soluble phosphate and calcium sulphate, or gypsum. It is made in various grades, the commonest in use containing 18% soluble phosphoric acid, known as *ordinary* or *single* superphosphate; and 40 to 45% soluble phosphoric acid, called *concentrated* or *double* superphosphate. Although soluble in water, superphosphate is not readily washed out of the soil, except perhaps during very heavy rains and in very light sandy soil. The old fallacy that it tends to exhaust the soil of lime and render it acid has been exploded. 2 to 4 cwt. of *ordinary*, or 1 to 2 cwt. of *concentrated*, superphosphate per acre are sufficient for most crops.

Basic Slag ("Thomas Slag") is a dark grey powder, obtained as a by-product in the manufacture of steel from pig iron. It contains varying quantities of citric-soluble tricalcic phosphate, according to the process employed—the "Bessemer," or "Open hearth" process. The Bessemer slag contains 18 to 19% phosphoric oxide (P_2O_5), equivalent to 40–42% of tricalcic phosphate. In the Open-hearth process the slag obtained contains less phosphate. From the fertilising point of view, Bessemer slag is therefore preferable, as it contains a larger percentage of phosphoric oxide and about 40 to 50% lime. Basic slag is rather slow in action, gives best results on heavy clay land, and is especially suited for pasture. Its lime content precludes its general use for Tea soils, though it is occasionally used for burying with green crops grown in Tea, but the little lime in 2 cwt. applications per acre does little harm, especially if sulphate of ammonia is used as a source of nitrogen. As a phosphatic fertiliser it is, generally speaking, less effective than superphosphate.

Ground Mineral Phosphates are mostly employed in the manufacture of superphosphate, but some are used as fertilisers, *e.g.* Algerian, Belgian and Ephos phosphates. These are mineral phosphates ground to a fine powder so that at least 80% passes through a sieve of 10,000 meshes per square inch, and contain their phosphorus in the form of insoluble calcium phosphate equal to 30, 20 and 27% phosphoric acid respectively. The effect of these is not quite so quick nor so good as that of superphosphate, but nevertheless they are cheap and are frequently used for various crops and pasture land. They have given excellent results on green crops grown in Tea.

Potassic Fertilisers are produced chiefly in Germany and Alsace. Liebig first stressed the value of potash for plants in 1840. Experiments begun at Rothamsted in 1843 have amply proved the value of potash as a fertiliser. The chief potash salts used in the tropics are:—

Sulphate of potash	containing	48·6% K_2O
Muriate of potash	,,	50·4% K_2O
Extra-kainit	,,	20 % K_2O
Kainit	,,	14 % K_2O

The first of these contains potash in the form of Sulphate of potash, and the others as Muriate- or Chloride of potash. These four salts are used according as they are best suited for the crops concerned: *e.g.* sulphate of potash is used for tobacco, potatoes, sugar-cane, fruit, etc.; muriate of potash for tea, coffee, etc.; and 20% Extra-kainit, or 14% kainit, for coconuts, because of its comparatively higher chloride content.

Plants take most of their potash in the early stages of growth, and this plant-food should therefore be applied before sowing or planting, not as a top-dressing. Potash and nitrogen are intimately connected in plant growth, the latter being chiefly concerned in the production of leaves, and the former in the growth of substance within the leaf and the reserve of plant-food. With potash-starved plants, where the supply of available nitrogen also is scanty, the leaves are few, small, and of little substance; the plant is stunted and the fruit or seed produced is scanty and small. Especially is this the case on light sandy soils. Where the supply of available nitrogen is plentiful, however, the leaves are greater in number and larger, but again produce less substance in themselves, and are soft, sappy and susceptible to attack from disease and insect pests. In the tropics, potash is a valuable plant-food for all crops, but is especially suitable for Tobacco, Coffee, Coconuts, Sugar-cane, fruit, etc.

Sulphate of potash contains a minimum of 48·6% pure potash (K_2O) in the soluble sulphate form. It is the purest form of potash on the market, and is therefore the most expensive. It supplies potash in an immediately available form, and is especially valuable for such crops as tobacco, root-crops, fruit, etc., giving better results than do muriate of potash or kainit. It may usually be applied at the rate of 1 to 2 cwt. per acre, but for certain crops larger dressings are given.

Muriate of potash contains a minimum of 50·4% available K_2O in the soluble form of muriate or chloride of potash. It is not quite such a pure salt as sulphate of potash and, owing to its chloride content, should not be used for tobacco, potatoes, fruit, etc. For ordinary purposes it is applied at the same rate per acre as sulphate of potash.

Extra-kainit contains 20% available K_2O as soluble muriate or chloride of potash. In the tropics it is used chiefly for coconuts, but is frequently found in proprietary complete fertiliser mixtures. It is not such a cheap form of potash as muriate of potash, especially where it has to be transported over long distances.

Kainit contains 14% available K_2O, also in the form of muriate or chloride of potash. It is chiefly used in the tropics for coconuts on account of its sodium-chloride content, and in temperate zones for pastures, or for killing or checking certain weeds, such as charlock. It represents the crude mineral as extracted from the potash mine and crushed. Muriate of potash and 20% Extra-kainit are merely concentrated forms of kainit.

Compound Fertilisers supply two or more of the three essential plant-foods, nitrogen, phosphoric acid and potash. There are a number of these on the market, and they have the advantage of effecting considerable economy in transport charges over long distances.

Ammophos (Ammonium phosphate) is marketed in two grades, one containing 10·7% nitrogen in the form of ammonia and 48% available phos. acid, and the other 16·45% nitrogen as ammonia and 20% available phos. acid. It is said to be equal in effect to sulphate of ammonia and superphosphate. Where it has to be transported over long distances, ammophos has a distinct advantage over straight fertilisers.

Nicifos is also a compound of nitrogen and available phos. acid. This also is

marketed in two grades, one containing 14·25% nitrogen as ammonia and 43% available phos. acid, and the other 18% N. and 18% available P_2O_5.

Leunaphos is a German fertiliser containing 20% nitrogen as ammonia and 20% available phosphoric acid, about 19·5% of the latter being water soluble.

Nitrophoska is seldom met with in the tropics. It is the name given to a series of highly concentrated compound fertilisers manufactured in Germany, and is available in several grades. It is composed of nitrogen, phos. acid and potash.

INDIRECT FERTILISERS

Lime (CaO) is a necessary element of plant-food. It enters into every form of vegetable life, and there are few soils that do not contain it in some form. As a constituent of plant-food, however, lime rarely needs to be added to the soil, but as an indirect fertilising agent it has often a most beneficial effect. In its caustic state it has a powerful effect in the decomposition of inert organic matter present in the soil, as well as in rendering available as plant-food certain elements present in an *unavailable* form. It improves the physical condition of soils, renders heavy or clay soils friable and permeable to air and rain, thereby encouraging the growth of soil bacteria, and converts an acid soil into an alkaline one. Soils containing less than ½% of lime cannot be brought to a satisfactory state of fertility.

Lime is valuable for pasture as well as for field and garden crops, whilst it is also a preventive of insect pests and fungus diseases, *e.g.* Club-root disease, which see. For garden plots, 8 to 12 oz. per square yard, and for field purposes 1 to 1½ tons of fresh slaked lime is usually a safe dressing. In hot countries the soil as a rule is less in need of lime than in temperate regions, owing partly to the more rapid rate of decomposition that naturally takes place in the former. It has, moreover, been found that certain tropical crops are partial to acid rather than neutral or alkaline soil, *e.g.* Tea, Coffee, etc. Clay soils are more benefited by lime than those of a loamy or sandy nature, and where little humus is present lime should be applied sparingly if at all. It will be found that frequently manured soils, as an old vegetable garden, will be much improved by a moderate dressing of lime every second or third year.

According to an old adage, " Lime pays the father but ruins the son," indicating the exhaustive effect of frequent liming without adding sufficient organic matter to the soil. This is also confirmed by another saying which runs :

" Lime and lime without manure,
Makes both farm and farmer poor."

The presence of lime is detrimental to certain plants, such as Rhododendrons, Ericas and some others. It should not be mixed with manure or fertilisers, and its application should, when practicable, precede the sowing or planting of crops.

Forms of lime. Lime occurs in nature in various forms, as dolomite (common in the tropics), coral, gypsum, chalk, etc. Coral lime, which is almost a pure carbonate, is commonly used for manurial purposes in Ceylon. It is imported from India and the Maldive Islands in hard lumps, and is either crushed to a fine powder and sold as *ground coral*, or burned in kilns and supplied as *burnt-lump* or *quick-lime*. The latter is the most active form, and is applied when freshly slaked with water as *hydrated lime*. Ground lime-stone and quick-lime have each their respective merit according to the nature of the soil, the former as the milder sort being more adapted to light soils.

Gypsum (*Calcium sulphate* or *Sulphate of lime*) is a combination of calcium and sulphuric acid. It is sometimes used to reduce the alkalinity of soils and in the preparation of certain insecticides. It liberates potash in the soil and renders it available as plant-food. It may usually be applied at the rate of about 3 oz. per square yard, preferably in wet weather. Gypsum is also known as "Land plaster," and is used to form " Plaster of Paris " and for making casts and moulds.

Chalk, a variety of carbonate of lime, acts both mechanically and chemically when used on light sandy soils, giving to these cohesion and the power of retaining soluble substances necessary for the support of plant-life. Chalk contains, in addition to lime, varying proportions of clay, sand, potash, etc.

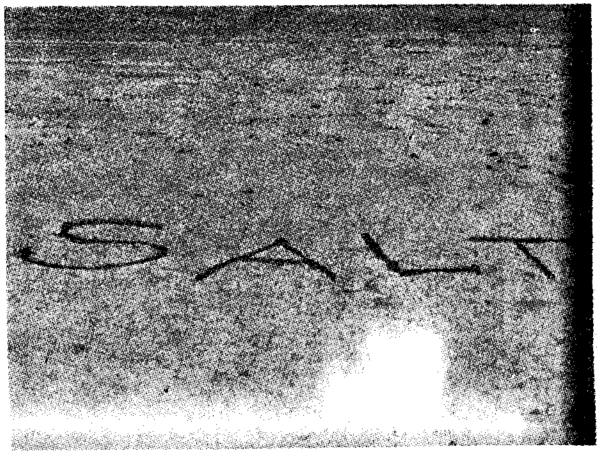
Ashes. Wood-ash usually contains a considerable proportion of potash (as carbonate of potash), lime and other elements of plant-food, thereby constituting a

valuable manurial substance. Coal-ash, finely sifted, also may have a beneficial mechanical effect on heavy clay soils, rendering these porous and friable.

Magnesium, a white powdery substance, always present in the ash of plants and therefore probably beneficial or essential to their growth. Indirectly, it acts as a fertiliser by uniting with insoluble mineral substances to form compounds of value as plant-food. It is considered that the ratio of lime to magnesia in soils has an important action on many crops.

Liquid Manure implies the urine of cattle (which is usually rich in potash and ammonia) or the drainings of dung heaps. But it may be made by diluting any kind of manure or fertiliser in a cask, using these in a liquid state. Manures thus dissolved are quicker in action than in a solid state and may be conveniently applied to garden crops and pot-plants. Such liquid may also be applied to manure heaps when more rapid fermentation of coarse organic matter is desired.

Soot is seldom obtainable in the tropics, but where it can be procured, as in cool regions, it is considered a valuable manure, being applied either in the dry state or dissolved in water. It is especially beneficial to garden crops and pot-plants, and has the effect of destroying or repelling ground-insects. **Soot-water** may be made by placing a sack of soot, with a stone inside, in a cask of water. As the liquid is taken out, more water is added.



Barren Salt Desert in Persia.

Salt (*Sodium chloride*). Common salt, which contains sodium and chloride, has been used for agricultural purposes from early times. In small quantities it is considered beneficial to some crops, especially such as are naturally found near the sea or in brackish soil, *e.g.* Coconut, Beet, Mangels, etc. Though salt in itself is of no manurial value, as an indirect fertiliser it is considered to have the effect of liberating potash and other plant-food in the soil. Bamber recommended salt for Coconuts at the rate of 1 lb. per tree. When present in excess, however, salt has a most injurious effect on plants, as may be seen in the salt-laden districts of Iraq, Persia, etc., where the prevalence of salt often makes cultivation difficult or impossible. The presence of 5% salt in a soil is sufficient to render it sterile ; hence salt is often used as a weed-killer.

COMPOSTS AND MIXTURES

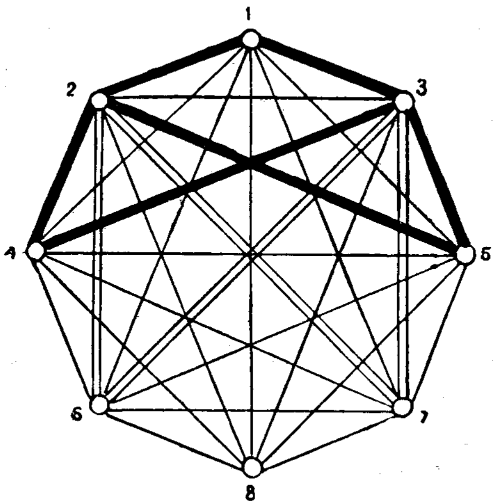
Compost is the name given in horticultural practices to a mixture of soil ingredients, organic manures, etc. In a more modern sense it is applied to "**synthetic manures**" consisting of leaves, litter, etc., soaked with water, mixed with fertilisers and any manure or other organic material available and allowed to decompose. A **mixture** generally refers to a combination of concentrated fertilisers, with or without such organic substances as oil-cake, blood-meal, guano, bone meal, etc. A soil compost implies a specially prepared medium for pot-plants, and may include loam or good surface soil, sifted leaf-mould, well-decomposed and broken-up manure, and a small proportion of fine sand and broken charcoal. The proportions may vary according to the nature of the plants for which they are intended and the quality of the ingredients; but for average purposes they may be in the ratio of 3, 1, 1, ½, ¼, respectively. (See *Pot Plants.*)

A mixture, as already stated, implies a *complete fertiliser* containing nitrogen, phosphoric acid and potash, in varying proportions according to the requirements of

the crop for which they are intended. An advantage of a complete mixture or fertiliser is that the different ingredients may be applied in one operation and, therefore, evenly distributed. While certain fertilisers may be mixed together with advantage, others are quite unsuitable for mixing, which would result in caking, rapid decomposition and loss of valuable plant-food. Thus, sulphate of ammonia should not be mixed with lime, calcium cyanamide, basic slag or nitrate of lime, because the lime in the latter interacts with sulphate-of-ammonia to liberate ammonia, thus resulting in a loss of valuable nitrogen. For similar reasons, certain fertilisers when mixed should be applied within 24 hours, *e.g.* potash salts with nitrate of lime, basic slag, or lime, whilst others may be mixed at any time without risk of loss of plant-food, *e.g.* sulphate of ammonia with superphosphate and potash salts. (See *Geehen's Chart.*)

SUITABLE MIXTURES

As already stated, the composition of complete fertiliser mixtures depends on the crops for which they are intended and should be made up according to the requirements of the crop in question. Obviously, it would not be economical to apply a Coconut mixture (for which crop potash is the dominant ingredient for fruit production) to Tea, which is a leaf-producing crop and generally requires more nitrogen than phosphoric acid and potash. It is advisable, therefore, to obtain expert advice before deciding on a mixture for any particular crop. The guiding principle, however, should be to obtain the plant-food necessary for maximum crop production from the fertiliser mixture, and to rely on cattle manure (if available in sufficient quantity) or green manure to supply the organic matter necessary to maintain the humus content and physical condition of the soil.



GEEHEN'S CHART SHOWING WHICH FERTILISERS MAY BE MIXED AND WHICH MAY NOT.

1, Superphosphate; 2, Lime; 3, Basic slag; 4, Sulphate of ammonia; 5, Farm-yard manure and guano; 6, Potash salts; 7, Kainit; 8, Nitrate of soda. Those fertilisers which are joined by thick lines should never be mixed before using; those joined by double lines, only immediately before spreading; those joined by a single line may be mixed together at any time.

The following are a few examples of suitable mixtures on average soils:

For Tea in North-East India, which has a short plucking season, fertiliser mixtures vary in general from 2 parts nitrogen to 1 of phosphoric acid and 1 of potash to 2–2–2 respectively, the most common being the 2–1–1 mixture as represented thus:

		N.	P_2O_5.	K_2O.
125 lb.	Sulphate-of-ammonia . .	25	...	...
140 „	Nicifos (18% N., 18% P_2O_5) .	25·2	25·2	...
50 „	Muriate-of-potash	...	...	25
315 lb. per acre per annum, supplying .		50·2 lb. N.,	25·2 lb. P_2O_5,	25 lb. K_2O.

For high yielding Tea gardens or estates, proportionately more of this mixture would be required, and it should be remembered that whilst for applications of nitrogen up to 60 lb. per acre per annum half that quantity of P_2O_5 and K_2O respectively is generally sufficient, for applications of nitrogen of from 60 to 90 lb. per acre per annum it is advisable gradually to increase the above proportions from 2–1–1 to 2–2–2 respectively, in order to obtain the maximum benefit in yield.

For Tea in Ceylon, where plucking takes place all the year round, the practice is to apply a *pruning mixture* either a few weeks before or at pruning, and a *general mixture* 6 to 8 months later. The former is generally composed of quick-acting inorganic fertilisers, whilst the latter usually contains both inorganic and organic material, such as poonac; this is intended to last from 18 months to 2½ years, but instead of applying it in one dressing, as is often done, it would be more economical and give better results to apply it in two or more smaller dressings at shorter intervals. The following are examples:

Pruning mixture:

		N.	P_2O_5.	K_2O.
150 lb.	Sulphate of Ammonia. . .	30	...	...
70 „	Concentrated Superphosphate .	...	29	...
60 „	Muriate of Potash . . .	...	...	30
280 lb. per acre, supplying . . .		30 lb. N.,	29 lb. P_2O_5,	30 lb. K_2O.

General mixture:

		N.	P_2O_5.	K_2O.
200 lb.	Ground Nut Cake	14	...	...
200 „	Blood Meal	22	...	...
200 „	Sulphate of Ammonia . .	40	...	...
100 „	Concentrated Superphosphate .	...	42	...
80 „	Muriate of Potash . . .	...	...	40
780 lb. per acre, supplying . . .		76 lb. N.,	42 lb. P_2O_5,	40 lb. K_2O.

During the recent tea slump many estates have resorted to purely inorganic general mixtures as being more economical. Such a mixture to supply approximately the above quantities of plant-food would be as follows:

		N.	P_2O_5.	K_2O.
240 lb.	Sulphate of Ammonia . .	48	...	...
155 „	Nicifos	27·9	27	...
35 „	Concentrated Superphosphate	...	14·7	...
80 „	Muriate of Potash . . .	...	...	40
510 lb. per acre, supplying . . .		75·9 lb. N.,	41·7 lb. P_2O_5,	40 lb. K_2O.

Coconuts:

		N.	P_2O_5.	K_2O.
150 lb.	Sulphate of Ammonia . .	30	...	...
200 „	Concentrated Superphosphate .	...	84	...
280 „	Muriate of Potash . . .	...	...	140
630 lb. per acre per annum, supplying .		30 lb. N.,	84 lb. P_2O_5,	140 lb. K_2O.

Coffee: Mixtures in the proportion of 2 parts N. to 3 of P_2O_5, and 4 of K_2O are recommended for coffee in South India. These requirements would be supplied by the following mixture:

		N.	P_2O_5.	K_2O.
100 lb.	Sulphate of Ammonia . .	20	...	...
150 „	Nicifos	27	27	...
110 „	Concentrated Superphosphate .	...	46·2	...
190 „	Muriate of Potash . . .	...	...	95
550 lb. per acre per annum, supplying .		47 lb. N.,	73·2 lb. P_2O_5,	95 lb. K_2O.

Cacao:

		N.	P_2O_5.	K_2O.
150 lb.	Sulphate of Ammonia . .	30	...	...
100 „	Concentrated Superphosphate .	...	42	...
100 „	Muriate of Potash . . .	...	...	50
350 lb. per acre per annum, supplying .		30 lb. N.,	42 lb. P_2O_5,	50 lb. K_2O.

Fruit trees: Mixtures for fruit trees should vary according to the kind of fruit in question, but a good general fertiliser mixture for an average sized fruit tree on average soil is :

		N.	P_2O_5.	K_2O.
250 lb.	Sulphate of Ammonia	50	...	...
150 „	Concentrated Superphosphate	...	63	...
200 „	Sulphate of Potash	...	...	97
600 lb., supplying		50 lb. N.,	63 lb. P_2O_5,	97 lb. K_2O.

Apply at the rate of 1 lb. per tree a year up to, say, 8 lb. or more per tree when 10 years old. The mixture should be scattered in a broad band round each tree and well forked into the soil, not nearer than 3–4 ft. from the stem, according to size and age of the tree. Forking should be deep, but without turning the soil over, so as to injure the surface roots as little as possible.

THREE GUIDING PRINCIPLES IN MANURING

Professors Wilfarth and Wimmer have found that the appearance of plants will sometimes afford an indication of what food they are most in need of, thus :

Nitrogen deficiency is indicated when the leaves lose their normal green colour and take on a light green or yellowish tint, drying finally with a clear brownish-yellow colour. Nitrogen increases the colour and vigour of foliage, but too liberal an application may divert the energies of a fruit-bearing plant to the production of foliage.

Phosphoric acid deficiency is shown by the leaves becoming a deep clear green, almost blue-green, later showing dark brownish spots, first at the margin and afterwards on the whole surface of the leaf. Phosphate promotes fruitfulness and early ripening of fruit crops.

Potash scarcity in the soil is said to be coincident with spots appearing over the whole leaf while the stalk and midrib retain their normal green colour, the leaf becoming yellowish and finally curling upwards. Potash improves the quality of fruits and flowers, increasing the sugar content of the former and the size and colour of the latter.

CHAPTER IV

GREEN-MANURE, COVER-CROPS, MULCHING, INTER-CROPS AND CATCH-CROPS

GREEN manuring consists in raising quick-growing herbaceous plants as a temporary crop, either alone or mixed with others, for the purpose of digging or ploughing the whole plants or loppings from them into the soil in a green state. This mode of enriching the soil is economical as well as efficacious, the fresh vegetable matter being returned to the soil with greater benefit than when it has been decomposed and much of its goodness has been lost in the process of rotting and fermentation. For improving the physical condition of light sandy soils especially, the use of green-manures or cover-crops is of the greatest value. Briefly, the principal benefits derived therefrom are :

(1) The supply of humus to the soil, which increases its capacity for retaining moisture.
(2) The prevention of surface-wash or soil erosion on steep land.
(3) Improvement of the mechanical condition of the soil by the action of the roots of the green-manure or cover-crops.
(4) Protection of the roots of main crops from excessive radiation from the ground surface.
(5) Suppression or reduction of weeds, and therefore economy of labour.
(6) Fixation of atmospheric nitrogen in the soil by leguminous species, especially those of the sub-order *Papilionaceae.*

They may be sown between the rows, or alternate rows, of the main crop and dug into the soil when large enough; or in the case of those of a perennial nature they may be lopped 3 or 4 times a year, the loppings being forked into the ground around the main crop. Those of a bushy nature, *e.g.* Tephrosia, may have to be uprooted after the 3rd or 4th year and re-sown. Shade trees, *e.g.* Erythrina, may be regarded as permanent, providing copious loppings at intervals. In some cases plants which also provide an edible crop, as beans of different kinds, may be employed with advantage for green-manure or cover-crop.

Whilst practically all plants are useful for adding organic matter to the soil when dug into it in a green state, yet all are not equally valuable. However well the first five of the foregoing benefits may be achieved by the use of non-leguminous plants, it is believed that only leguminous species have the power of utilising and fixing the free nitrogen of the air. (See *Nitrogen-collecting nodules.*)

In selecting plants suitable for this purpose, those of a herbaceous bushy character and rapid growth, capable of forming a good cover in a short space of time, should be chosen. The following species, all belonging to the family of *Leguminosae,* except where otherwise mentioned, are recommended :

[*S* = Sinhalese; *T* = Tamil.]

Astragalus sinicus. Small shrub, extensively grown in China and Japan as a soil renovator on paddy land.

Cajanus indicus. Pigeon-pea; Dhall; Rata-tora, *S.* Shrub, 6 to 7 ft. Sea-level to about 3,000 ft. See *Food Products.*

Calopogonium mucunoides. A good ground-cover for Coconuts; said to make a complete cover 2 ft. thick in five months; also recommended for young rubber.

Canavalia ensiformis. Sword-bean; Wal-awara, *S*; Koli-avarai, *T*. Perennial twiner or creeper (also a bush form), suited to low-country. Young pods and seeds edible. Large seeds; sow singly at 2 to 3 ft. apart, say 8 lb. per acre.

Centrosema Plumieri. Butterfly Pea. Small, annual, slender, creeper, of Trop. S. America, with trifoliate leaves and large white flowers with a dark crimson centre. 2½–3 lb. seed will sow an acre if dibbled in at 2½ to 3 ft. apart. Naturalised in Ceylon at low elevations; a good ground-cover for Coconuts or Hevea. Cattle relish the loppings. *Centrosema pubescens*. a similar species of S. America, is used as a ground-cover in Java, etc.

Crotalaria juncea. Sunn-hemp; Hana, *S*. An erect annual shrub, 5 to 6 ft. Semi-dry low-country. (See *Fibre Plants.*)

C. striata. Herbaceous shrub, 3 to 4 ft. Low-country up to 3,000 ft. Sow between crops, or in rows about 2 ft. apart; say 3 lb. seed to the acre.

Desmodium Wightii. A perennial herb, 3 to 4 ft. high. Low-country.

Dolichos biflorus. Horse- or Madras-gram; Kollu, *S*. Small, close-growing, perennial, creeping herb. (See *Vegetables.*)

D. Hosei. Creeper. Forms a dense covering in a short period. Considered a good ground-cover for low-country. Does not seed freely.

Indigofera endecaphylla. A small, close-growing bush, 12–15 in. high, forming good cover.

I. tinctoria. Indigo. Nil-awari, *S*. Shrub, low-country, 3–4 ft. (See *Dyes.*)

Leucaena glauca. Lamtoro. Small quick-growing tree with very fine bipinnate leaves. Suitable for green-manure or low shade for young crops. Valued in Java as shade for Coffee. (See *Shade for Crops.*)

Mikania scandens. *Compositae.* Loka-pa-lu, *S*. ("World ruin"). Annual, quick-growing, spreading, herbaceous creeper; flowers October–January, scented. Cattle relish it. Sometimes known as "A mile a minute." (See *Weeds.*)

Mucuna utilis (= Stizolobium deeringianum). Velvet-bean, etc. Annual twiner or creeper. Thrives in low-country up to 3,000 ft. (See *Vegetables.*)

Parochetus communis. A low, creeping, quick-growing plant, found at high elevations throughout Asia; considered a promising ground-cover for up-country.

Phaseolus lunatus. Bonchi or Dambala, *S*. Herbaceous twiner. Thrives up to 3,000 ft. or higher. (See *Tropical Vegetables.*)

P. trinervius. Jerusalem Pea. Perennial twining herb, with yellow flowers and hairy stems; common in Ceylon, India, etc.; 1,000–4,000 ft. elevation.

Psoralea corylifolia. Bodi, *S*; Kavoti, *T*. Annual, 1–3 ft., dry region.

Pueraria thunbergiana. Kudzu; Ko-hemp. Herbaceous creeper, much cultivated as a ground-cover in China and Japan. Starch is obtained from the tuberous roots, and fibre from stems; leaves and shoots edible. (See *Fibres.*)

Sesbania aculeata. Danicha or Dhanicha (India). Annual, 3–5 ft. Common in low-country, especially dry region; often a weed in paddy fields. **S. aegyptiaca.** A tall, quick-growing species, suited to dry regions. (See p. 205.)

Tephrosia purpurea. Kavilai or Kolinchi, *T*; Pila, *S*. Perennial herb, 2–3 ft.; common in low-country. Used in Jaffna as green-manure for Tobacco.

T. candida. Boga-medeloa. Shrubby perennial, 4–6 ft. Soft pubescent foliage; white fl's. Suited up to about 4,000 ft. Yields 4 cuttings a year, or 58 tons green manure per acre. Re-sow after 3 years. Sow 3 seeds together in holes 3 ft. apart, between crops, using about 3 lb. seeds per acre.

Trifolium alexandrinum. Berseem, or Egyptian clover. Much esteemed in Egypt, Syria, Iraq, etc. as a soil renovator and forage crop, under irrigation. (See *Fodder Plants.*)

MULCHING OR SURFACE-COVER

Mulching consists of placing on the surface of the soil a layer of any organic substance, such as leaves, straw, twigs, grass mowings or any litter with the object of checking the evaporation of moisture. It prevents the surface soil forming a hard crust, and at the same time adds humous material to the soil, while it also checks the growth of weeds. The object

of mulching is also met by maintaining the surface soil in a state of fine tilth, or placing upon it a layer of fine sandy soil, this being sometimes referred to as *natural mulching*, the former being known as *artificial mulching*.

The effect of these is to cut off the upward flow of underground moisture at a point below the actual surface, and to prevent its rapid escape into the air during very dry weather. A surface-cover of leaves, or of any rapidly decaying organic matter, will serve the purpose of maintaining the soil in a state fit for the nitrifying bacteria to function in a period of drought. The following are some of the principal trees or shrubs whose leaves or young twigs are commonly used for mulching in Ceylon. (See also *Shade Trees for Field Crops.*)

* Leguminous family.

Adhatoda vasica. Adathodai, *T*. Shrub, 5–7 ft. Leaves and young twigs commonly used in the north of Ceylon as a green-dressing for field crops.

Aleurites triloba. Candlenut Tree; Kekuna, *S*. Leaves collected and spread on the field and ploughed in. (See *Wood Oil.*)

Azadirachta indica. Margosa; Kohomba, *S*. Leaves used as mulch in Tobacco cultivation at Jaffna, etc. (See *Shade Trees.*)

Calotropis gigantea. Wara, *S*. Large, quick-growing shrub. (See *Fibres.*)

***Cassia auriculata.** Ranawara, *S*; Avarai, *T*; Matara Tea. A sea-coast shrub, 5–8 ft. (See *Native Med. Plants*, etc.)

Croton lacciferus. Keppetiya, *S*. A small tree; leaves commonly used as a mulch in Betel cultivation. (See *Lac.*)

***Erythrina lithosperma.** Dadap; Muringa-mara, *T*. (See *Shade Trees.*)

Ricinus communis. Castor-oil Plant. (See *Fixed Oils.*)

***Tamarindus indica.** Tamarind; Siyambala, *S*. Leaves commonly used for surface-dressing for Tobacco in dry region. (See *Shade Trees.*)

DADAP (*Erythrina lithosperma*). Showing scarlet fl's. (1), and pods (2).

Thalassia Hemprichii and other species of Seaweeds. Chatalai or Sathalai, *T*. Commonly used as mulch for Coconuts and paddy fields near the coast.

Tithonia diversifolia. Mexican Sunflower. Used as dressing on paddy fields, etc. (See *Weeds.*)

INTER-CROPS AND CATCH-CROPS

The growing of mixed crops on the same land has certain natural advantages over the exclusive cultivation of single products, and although for economic reasons the latter system is usually adopted, it obviously lends itself to the spread of pests or diseases (see *Insect Pests*). Plants in their natural state, where numerous species and families are found growing together, are seldom subject to such epidemics.

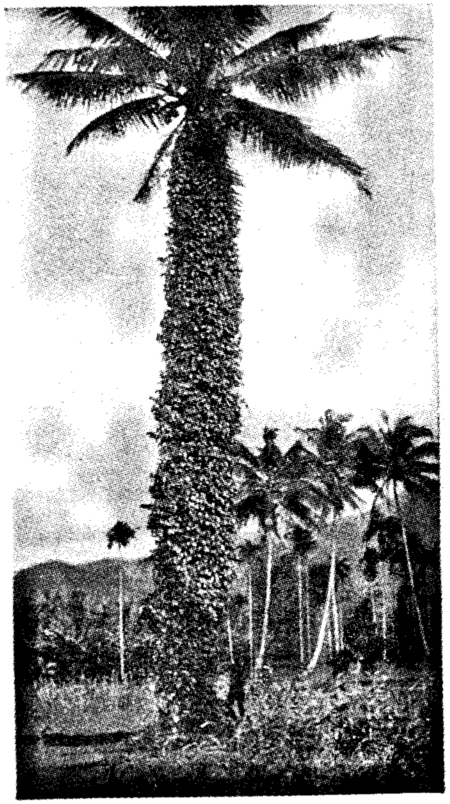
Advantages of subsidiary crops. From a practical standpoint the main advantages claimed for inter- or catch-crops are: (1) revenue may be obtained during the interim of waiting for a main crop which may take several years to come into bearing, *e.g.* Rubber and Coconuts; (2) weeds may be kept in check, and therefore upkeep costs are reduced; (3) beneficial shade may be afforded the main crop; and (4) there is less liability to the spread of insect pests.

Disadvantages of the practice of inter-cropping may, on the other hand,

be met with, as when unsuitable combinations of products are chosen. The soil may become unduly exhausted, the inter-crop or catch-crop may retard the growth of the principal crop, and the proper attention of the management and labour force may be diverted from the latter, while the cost of harvesting may be increased. Nevertheless, there is always a demand for suitable quick-yielding catch-crops for planting among slow-growing perennial crops, such as Rubber (Hevea), Coconuts, Cacao, etc.

BOGA MEDELOA (*Tephrosia candida*). An excellent green-manure crop.

The following are examples of crops suggested for inter-cropping or catch-cropping. The former term implies crops of a perennial nature, while the latter indicates annual crops or those of short duration and yielding quick returns.



AN EXAMPLE OF NATURAL INTER-CROPPING. PEPPER ON COCONUT PALM.

Inter-crop examples.—*Tea with Hevea Rubber*, the latter at the rate of about 30 to 40 trees to the acre, at low elevations.

Cacao with Hevea Rubber, the latter at the rate of about 25 to 30 to the acre and serving as shade trees for the Cacao.

Cacao with young Coconuts, until at least the latter come into full bearing.

Coca (*Cocaine*) *with Hevea Rubber*, until the latter covers the ground.

Coffee, especially C. robusta, C. Quilou, etc. much grown with young rubber in Java, Sumatra, and Malaya.

Coconuts and Rubber, sometimes planted in alternate rows.

Citronella or other oil grasses with Rubber, the latter being widely spaced.

Pepper as a creeper on shade trees among Tea, Coffee or other crops, or on trees along roadsides, etc. at low elevations.

Vanilla (a creeper) on shade trees, among Tea or other crops, or along roadsides, etc.

Ipecacuanha, grown as an inter-crop in Brazil, also to some extent on young Rubber plantations in Malaya.

Catch-crop examples. Annual crops, such as cotton, cassava (tapioca), chillies, gourds, ground-nuts, arrowroot, tobacco (grown on young rubber clearings in Sumatra), etc.

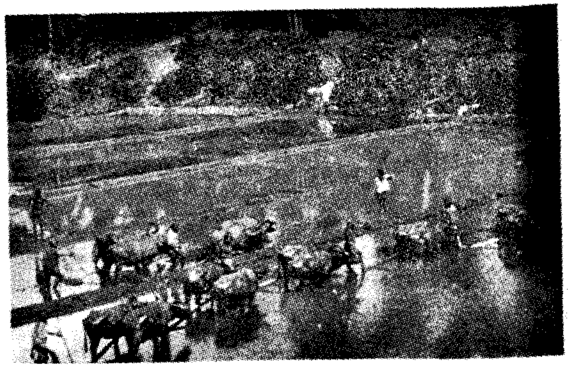
CHAPTER V

SOIL OPERATIONS

Tillage. The main objects of tillage, whether in the form of digging, forking, ploughing, or otherwise, are: to loosen the soil so as to facilitate the absorption of rain and the admission of fresh air; to enable the roots of growing plants to penetrate the soil more easily; and to control the growth of weeds. Tillage should aim at maintaining a proper supply of moisture in the soil, rendering the latter permeable to rain and encouraging the activity of soil bacteria. It is the first essential of cultivation, more especially for root-crops. Plants can only derive full benefit from manures or fertilisers when the land is maintained in a proper state of tilth. Deherain showed that "trituration or pounding of the soil is a powerful method of causing active nitrification." According to an old adage,

"Tillage hinders 'vaporation,
Tillage works weed 'radication,
Tillage helps food 'laboration."

Modes of Tillage. The different methods employed for tilling the land vary considerably in different countries, according to the means available, though the principle underlying all is the same. From the wooden spikes or flint spears which in early times served the purpose of stirring the soil, as they do even now in some primitive countries, to the modern steam or motor plough now used on large farms, is a great stride in the evolution of agriculture. Digging by means of spade, fork, mamoty, or kodali (see *Tools, etc.*) is adapted to confined areas, as gardens, etc., but good ploughing, followed by harrowing or similar means of levelling and smoothing the surface, is best suited for the preparation of the ground for field crops. Ploughing as carried out in the East, with buffaloes, oxen or yak as draught animals, is often of a very primitive nature, the soil being merely stirred or scratched on the surface rather than turned over in a furrow. In some cases, as in Rice cultivation, it is merely puddled or churned by means of wading buffaloes or bullocks, being first softened by flooding with water.



PLOUGHING RICE-FIELDS, CEYLON. (See Paddy, or Rice.)

The so-called plough generally used by the peasants of Ceylon, India, etc. consists of a simple wooden implement with a small iron pointed socket for a coulter. The whole plough may weigh but a few pounds, so that a coolie can readily sling it on his shoulders and carry it to wherever desired. Heavier and more substantial ploughs

have from time to time been introduced, but so far the natives generally prefer their own primitive article, which perhaps is best suited to their special requirements.

Use of explosives in Tilling. As a means of breaking up a hard, impervious subsoil, more especially in the preparation of large holes for planting trees, the practice of exploding dynamite charges buried in the soil has recently been much advocated, and, where the cost is not objected to, is generally attended with beneficial results. The immediate effect is to break up the hard pan or lower stratum in a way which cannot be achieved by deep ploughing or trenching. A hard sub-stratum may thus be made penetrable to the roots of plants or crops, allowing of the free percolation of water and liberating essential elements of plant-food. For ordinary subsoiling, a 2 oz. cartridge to each hole (costing about 3*d.* or 4*d.*) is sufficient. More powerful charges of 3 or 4 cartridges may be used for blowing up tree stumps or breaking obstructive boulders, but in this case the operator must seek safety behind a tree or other object after lighting the fuse.

For holing purposes, the method of procedure is thus : Bore a hole with a crowbar where planting is to be done, about 2½ ft. in depth. At the bottom of the hole, place the cartridge of dynamite, provided with a detonator and fuse. Then fill the hole with moist earth and press down gently, leaving about 15 in. of the fuse projecting on the surface. On exploding the cartridge, the surface of the earth will be seen to rise a few inches and subside, and after a few minutes smoke is seen to issue from the cracks in the earth. On removing the earth loosened by the explosion, it will be found that a round hole is formed at the point where the cartridge was laid, with innumerable fissures extending for a few feet into the surrounding soil. Dynamiting is especially beneficial in the planting of trees, the hard bottom of the holes being thus well broken up.

Ploughing in Persia.

Fallowing is sometimes adopted for the purpose of resting the land and restoring its fertility, after a series of annual crops have been harvested. A rest is thus provided for the soil, during which a new supply of plant-food is stored up, and this becomes available for succeeding crops. For perennial crops, however, such as Tea, Cacao, Coconuts, and Rubber, fallowing cannot obviously be adopted, and manuring and tillage operations must then be relied upon to meet the requirements of the crops grown. Fallowing has also the effect of ridding the soil of plant diseases and insect pests.

ROTATION OF CROPS

Plants differ, as shown by their ash, in the relative proportions of plant-food they require and obtain from the soil. Therefore when successive crops of one kind are grown on the same ground, those elements which are most consumed obviously become exhausted. Consequently the soil becomes " poor " or unproductive, the crop weak and sickly, and even the application of costly manures may not satisfactorily restore fertility. (See *Insect Pests* and *Fungus Diseases.*)

The principle of rotation is to prevent two crops of the same nature succeeding each other, and in cool countries its adoption is often made compulsory. Nevertheless, there are cases in which the same kind of crop is, with suitable manuring, successfully grown annually in the same ground for many years without change, as in the case of rice, sugar-cane, etc. In the tropics regular rotation is often impracticable, owing to the fact that many of the crops grown are of a perennial nature and, once planted, last from a few to a great many years, *e.g.* Rubber, Tea, Coffee, Cacao, etc. But wherever possible, as in the case of garden or annual crops, the principle of rotation should be practised. In the wasteful method of **chena cultivation,** common in Ceylon and other parts of the tropics, virgin land is cleared, cultivated for a season or two, and then abandoned.

In the practice of rotation other benefits also accrue. Certain roots penetrate the ground deeper than others; these aerate the subsoil and, when the crop is removed, remain in the ground to rot. Insect pests are checked, as these may die of starvation when a crop on which they do not live or feed intervenes. Weeds, too, may thus be checked or exterminated. When plants of one kind are grown together in great numbers and for many succeeding years, they are prone to attacks of insect pests and diseases. Any system of rotation adopted must, of course, vary according to the variety of crops it is desired to grow. Willis recommended the following 4-year course for chena lands in Ceylon :

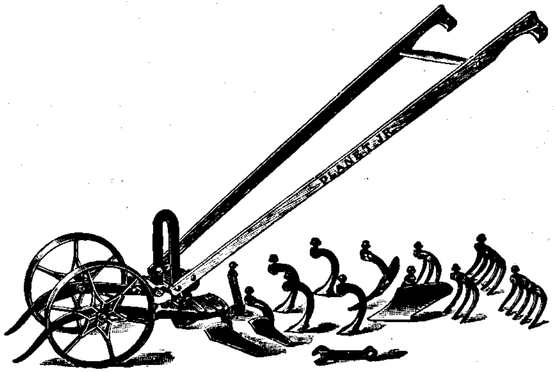
First Year : Tobacco, Indian-corn or Maize, Cotton.

Second Year : Root crops, *e.g.* Cassava, Sweet-potatoes, Yams, Arrowroot, Onions, Ginger, Turmeric, etc.

Third Year : Dry grains (*e.g.* Kurrakan), Chillies, Gingelly, Gourds, small fruits, Castor-oil plant, grasses for fodder, Mustard, Murunga.

Fourth Year : Gram, Ground-nuts, Peas or Dhal, or other leguminous crop.

For Tobacco land, Drieberg recommends a 3-course rotation, thus :—(1) Tobacco; (2) Cotton or leguminous crop, *e.g.* Beans, Grams, Ground-nuts, etc.; (3) Grain-crop, *e.g.* Paddy, Kurrakan, Amu, Maize, etc.



Wheel Cultivator, Rake, Plough, etc.

For garden crops, the following rotation is recommended :—(1) Cabbage, (2) Carrots or Beet, (3) Peas, (4) Celery, (5) Potatoes.

IRRIGATION

Irrigation is practised chiefly in dry countries, where the cultivation of crops may be entirely dependent upon it, as in semi-desert regions. (See p. 201.) In a moist climate, *e.g.* the south-west of Ceylon, irrigation is necessary only in the cultivation of Rice or other aquatic crops. Intermittent irrigation may, however, be applied with good results to other crops, especially fruit crops, in localities where the rainfall is limited or unevenly distributed over the seasons.

The methods of accomplishing irrigation are variable, and usually depend upon the facilities available, the water being conveyed from natural sources or reservoirs to the land by means of canals, streams, pipes, or spouts, or raised by pumps from artesian wells or other sources. In parts of India and in the dry districts of Ceylon, irrigation water is hauled up from deep wells by means of a long stout pole or tree-trunk unevenly balanced on the principle of a see-saw over the well, the balancing being done by 3 or 4 coolies who walk up and down the pole, the heavy end of which each time it rises brings up the water in buckets, skin-bags or other receptacles, which are emptied into channels by a man standing at the well side. On this principle is the **shadoof** of Egypt, Arabia, etc. which is as old as the Bible.

A mode in general use in India is by means of a large bag made of bullock-hide; the bag is suspended from a pulley over the well, and is drawn up by a pair of bullocks

as they are made to run down a declivity. The **Persian wheel** method of raising water is commonly adopted in Persia and Northern India. This consists of a large vertical wheel, fixed in the mouth of a well; over it a looped chain of earthenware pots is suspended, the lower of which reach the water. As the wheel revolves, one length of the chain is continually rising with pots full of water, which discharge themselves into a trough fixed at the summit, and return empty to be filled again. The wheel is worked by means of bullocks tied to a beam and a horizontal wheel. **Wind-mills** are employed in some countries very successfully for raising water from wells.

The **terracing** system is adapted for sloping land and comprises a series of contour banks and channels; the water is conducted to the upper terrace, spreads over the surface and escapes through regular outlets into the next, and thence to the one below, and so on. A good example of this is seen in the terraced rice-fields on hillsides in Ceylon and the terraced vineyards in Syria, etc. **Artesian wells** and tube-wells are largely used in some countries, as in Australia and parts of India, being especially suitable where the soil is loose and sandy.

In countries where large rivers traverse low-lying land, as in the case of the Nile in Egypt, the Tigris in Mesopotamia, the Ganges in India, and others, the river water with its rich mud is conducted by gravitation in canals, creeks, and channels over the country, and on this every form of cultivation may be said to be entirely dependent. Great reservoirs have been made in Egypt, India, etc. to accumulate and conserve important supplies of water, rendering irrigation less dependent on the fluctuating rises of great rivers. Some of the larger **irrigation tanks** in Ceylon have an area of over 4,000 acres and resemble large and beautiful lakes. An important principle of irrigation is that the water should not be too rapid in its flow, nor allowed to remain on the land longer than necessary. A system of distributing channels has to be devised according to circumstances.

DRY FARMING

The term "dry farming" is applied to a system of cultivation adopted in dry districts, without irrigation, the object being to conserve moisture in the soil, or to increase the capacity of the latter for storing water, mainly by the following means:

(*a*) Deep and thorough preparatory tillage; (*b*) level culture (not raised in ridges); (*c*) "packing" the soil with a "subsoil packer" and heavy rolling. A subsoil packer is an implement the object of which is to press a light sandy subsoil, while the surface-soil is left in a loose condition. Supplementary to these are frequent inter-tillage, deep sowing, wide spacing, and the selection of deep-rooting and drought-resistant crops. In the case of grain crops, the seed should be soaked in water before sowing so as to ensure rapid and uniform germination, while in planting operations the soil is well pressed round the plants. By these and similar means increased crops are said to be obtained in districts where the rainfall is small.

DRAINAGE AND SOIL EROSION

Drainage, natural or artificial, is essential to all cultivated soils. The objects of drainage are, briefly, to enable the rain to become absorbed by the soil and filter through it; to render the soil porous, whilst maintaining a sufficiency of moisture for the crops; to remove superfluous moisture and prevent stagnant water remaining in the soil. A porous soil contains small spaces between its particles, and these, when not occupied by water, are filled with air, which conduces to bacterial activity and nitrification and is essential to plant-growth.

Some lands are naturally drained, so that when rain falls on them it percolates through without leaving the soil sodden or saturated. Soils not naturally drained become water-logged, acid and cold, causing crops or plants to suffer from "wet feet," or the roots to rot off from the ends. Water is colder than air, and a wet or water-logged soil is therefore always colder than a porous or well-drained one.

Surface or Contour drains. Open drains at certain intervals are essential on steep lands, so as to check soil erosion, *i.e.* the washing away of the surface soil caused by torrential rains. This system of drainage is extensively employed

throughout the Tea-planting districts, and is indispensable to the preservation of the soil. The drains are usually about 2 ft. in depth, with a gradient of about 1 in 25 to 1 in 40, while the distance apart varies according to the gradient and character of the land. On very steep land and in dry localities, the gradient may be reduced to almost a minimum, while the distance between the drains should not be more than 25 to 30 ft.; on less steep slopes, however, the latter may be as many yards or more. Catchment pits should be made in the drains at intervals of 50 ft. or so, the silt and valuable surface soil trapped by these being removed regularly and spread on the ground above them.

Drains in the tropics should, whenever possible, be open, not closed over. In gardens or ornamental grounds, however, open drains are unsightly, if not impracticable, and for that reason they should as a rule be covered. In making a covered drain, drainage tiles or stones should be put in the bottom of the trench, placing these so as to leave large spaces between, finishing with a layer of smaller pieces; brushwood, fibre, or straw should be placed over this, and the soil then filled in. (See *Drains and Culverts*.) By **terracing** steep land, as in a garden, the necessity for drains is largely obviated.

Contour hedges of low shrubs, preferably of the leguminous family, such as *Tephrosia candida*, *Indigofera arrecta*, *Clitoria cajanaefolia*, etc. planted across steep hill-sides are also a useful precaution against soil erosion. They may be planted at intervals of 10 to 20 yards or more, according to gradient. Even the crop itself, if so adapted, may be planted in the form of hedges on steep hill-sides liable to erosion, as is sometimes done in the case of Tea.

Soil-erosion, or the washing away of the soil due to torrential rains, is especially common to tropical countries and varies in intensity according as the land is steep or hilly, or is subject to heavy rainfall. It has been ascertained from experiments in Ceylon, on steep tea land of uniform gradient, that nearly 17 tons of soil per acre per annum were thus lost or washed away where no special preventive measures were taken. By growing a cover-crop of *Indigofera endecaphylla* this loss was reduced to about 9½ tons per acre. Cover-crops of suitable kinds are therefore of special importance as a preventive of wastage of soil by erosion.

CHAPTER VI

PROPAGATION

Plants are propagated in various ways; some which increase at a rapid rate by one method cannot be similarly raised by another, while in some cases all methods of propagation fail. The following are some of the principal modes of propagation practised:

By Seed is the most natural mode of increase, and is the one by which the vast majority of plants naturally spread and produce their kind, the offspring being more or less true according as the flowers are disposed to be self- or cross-fertilised. Plants are naturally rejuvenated by seed reproduction as compared with vegetative propagation, which is merely a continuation of the same individual. The production of seed may thus be said to be the object of the life of every plant in a state of nature. But as exact counterparts of the parent plants cannot be depended on by raising from seed, propagation by vegetative means, as by cuttings, buds, grafts, etc. is often resorted to in cultivation. (See *Fruit Culture*.)

Selection and Saving of Seed. In the raising or saving of seed of most kinds, it is important that selected plants or trees should be set apart as seed-bearers and cultivated with special care, so as to encourage the production of perfect seed from well-nourished parental stock. Seed-bearers should be selected according to their individual performance, the seed from each being measured, counted or weighed, depending on the nature of the crop. Further, the seeds should be selected individually, eliminating small or inferior ones. Unproductive or imperfectly formed flowers or fruits should be discarded or removed.

Vigour may be concentrated in the seed by thinning these out and retaining only the best heads or fruit. This not only applies to annuals grown for ornament or use, but also to fruit and field crops, as Tea, Coconuts, Cacao, Coffee, Cotton, Rubber and other products. It is important that seeds should be perfectly ripe before they are gathered, as otherwise their germination and the vitality of the seedling will be affected. Change of seed from one district or country to another has often a beneficial result on the crop, and the practice is generally to be recommended. (See *Plant Breeding*.)

Vitality of Seeds. In the case of some species seeds, if carefully stored, may retain their vitality for several years, *e.g.* many leguminous and palm seeds; but after full maturity, all seeds, it may be said, decline appreciably in vigour with age, and the progeny of old seed is generally less robust than that from seed freshly harvested. Most seeds germinate best if sown as soon as ripe.

In the case of plants of the Gourd family (*Cucurbitaceae*), however, seed which is not quite fresh is sometimes preferred, as this is considered to yield plants of a more fruitful and less leafy nature. Certain hard-coated seeds, as Manihot (Ceara-rubber), are said to germinate best when at least a year old. (See *Testing germinative capacity of Seeds*.)

Sowing Seed. Seeds vary in size and character so much that no hard-and-fast rule can be laid down for sowing. Most seeds, however, are best sown in fine,

light soil which has been sifted or pulverised and made easily permeable to the young roots and plumule. The soil surface should be lightly and evenly pressed down; this will ensure small seeds being sown at a uniform depth, and aid in maintaining a moist surface. If the presence of insects or snails' eggs be suspected, boiling water may first be poured over the seed-bed or pot in order to kill those within reach. The depth at which seeds should be sown varies according to their size. A general rule is to cover seeds with a depth of soil equal to their smallest diameter, but to this rule there are many exceptions. Large seeds should usually be buried just below the surface, whilst very small seeds need only be covered with a sprinkling of fine soil. Peas, beans and seeds of similar size may be sown at a depth of about 1 in.; for smaller seeds, such as onions, carrots, beet, etc., less than half that depth is sufficient. Seeds sown in a field, plot, or nursery-bed require to be buried deeper than is necessary for germination, so as to protect them from vermin, etc., and to allow for soil-wash by heavy rains. Those which take long to germinate, as nutmeg, palms, etc., should be sown at least an inch below the surface. In all cases of garden or field crops, the seed should, whenever practicable, be sown in rows, not broadcast if avoidable, except grain crops of course. Sowing in rows economises seed and facilitates attention to the crop in regard to weeding, watering, thinning out, etc. (See *Nurseries*.)

Position of Seed in sowing. Large seeds are in some cases affected in their germination by the position in which they are sown, although this is a matter seldom taken into account. Deformity in seedlings is often due to faulty position of the seed in germination, the shoot or plumule in consequence becoming entangled with the stalk of the seed-leaves (*cotyledons*). Generally speaking, the *micropyle* or root end of a seed should be downwards. Petch found that out of 50 Hevea seeds sown horizontally, with the inner or flat surface downwards (considered the correct position), 48 germinated normally, while from a similar number sown vertically with the micropyle uppermost, only 9 normal plants were obtained. In the case of Coconuts, it is customary to sow the nuts on their side, with the stalk or broad end slightly raised, half covering the nuts with soil.

Sowing at stake, or *in situ*, which is sometimes adopted in the case of field crops, as Rubber, Tea, etc., consists in sowing seed in the position which the plants are to occupy when grown up; thus, holes are prepared in lines and filled in, the centre being marked by the stake used for lining; one or more seeds are sown close to the stake, the weaker seedlings being afterwards removed as may be required.

Bulking Fine Seed. In sowing very small seeds, as those of some annuals, one is very liable to sow too thickly. A good plan is to "bulk" such seed by mixing with it finely sifted dry soil, fine sand or sawdust; this enables the seed to be sown more thinly and evenly than would otherwise be possible. When seedlings are large enough to handle they should be carefully thinned out or regulated, retaining the stronger ones and discarding the weaker.

Basket- or Bamboo-plants from Seed. For most trees or shrubs, an excellent plan is to sow the seed in plant-baskets or bamboo-pots; if of uncertain germinative capacity, two or three seeds may be sown together, the weaker seedlings being afterwards removed, leaving only one in each basket or bamboo joint. This method of raising plants not only facilitates transport, but also enables the young plants, with their roots in the soil intact, to be planted out almost irrespective of weather conditions. Thus, the advantage of basket-plants over "stumps" or seedlings from nursery-beds is obvious, and the former are usually well worth the extra cost entailed. Where baskets are not obtainable, sections of bamboo with one node left intact, except for a hole pierced through it for drainage, will answer the purpose; but these, unlike the plant-baskets, must be removed when planting out. This is easily accomplished thus: split the bamboo pot along two sides with a blow from a knife; lay the plant on its side and invert the two halves of bamboo; place the plant (with bamboo) in hole, fill in the soil around it, and pull out the bamboo halves.

Germination of Seeds. The seed consists of three distinct parts, viz. the germ, the body, and the skin (see *Seeds* under *Plant Life*). The germ (*embryo*) comprises a rudimentary plant, with the leaves and stem in an undeveloped state. The body (*endosperm*) is the reserve food which nourishes the embryo in the process of germination, until the root is advanced enough to derive nutriment from the soil. The skin or shell (*testa*) of the seed is for the purpose of protection. Four conditions essential to successful germination are: (1) a certain amount of moisture, (2) a favourable degree of heat, (3) fresh air, and (4) protection from strong light. In the absence of any of these conditions successful germination cannot take place.

When the seed-coat or shell is hard and horny, it precludes air and moisture from the embryo, and thus prevents germination until it has sufficiently decayed. Seeds with a very hard shell or endosperm take a long time to germinate, varying from 3 or 4 months, *e.g.* Nutmeg, to a year or more, as in the case of certain palm seeds. In some cases, however, germination may be assisted by filing or rasping the horny shell, as in the case of Ceara-rubber seed (*Manihot*), while in the case of seeds with a very hard endosperm, as *Canna*, or hard testa, *e.g. Acacia* and other leguminous species, they may be steeped for about 3 days in changes of almost boiling water.

The rasping or filing process may be carried out by holding the seed for a few seconds against a revolving grindstone. A coolie with a seed in each hand, while another coolie turns the handle, will thus soon get through a large number of seeds. The " bush method," sometimes adopted for hard-shelled seeds, is to burn a bundle of hay or ferns over the seed-pot or seed-bed, afterwards watering the soil with a fine rose. Germination of very hard seeds may be facilitated by placing these in a hot fermenting dung-heap for 2 or 3 weeks. This has been found successful in the case of *Canna* (Indian-shot), *Manihot* (Ceara-rubber), *Elaeis* (Oil-palm) and others. Soaking such seeds for about 5 minutes in a solution of sulphuric acid is also reported to have had good results. Other aids in hastening germination are: (1) soaking the seeds in a solution of camphor with water; (2) in chlorine water (2 drops chlorine to 60 c.c. of water); (3) in a weak solution of formic acid (1 in 500); (4) or in a weak solution of ammonia. Some seeds germinate naturally in the fruit when ripe, e.g. *Sechium*, *Rhizophora*, *Vateria*, etc.

Testing germinative capacity of Seeds. A popular way is to place them in water; if they float, they are presumed to be bad, and the reverse if they sink. This, however, is sometimes misleading, as some seeds float though perfectly germinable or sink when in a bad condition. Seeds will either sink or float according to their specific gravity, often irrespective of their germinative capacity. However, those which sink when good are of doubtful character when they swim, and *vice versa*. A strong saline solution, made with common salt, is employed in Japan for testing rice and other seeds. In this case all seeds that float are rejected, and those that sink selected for sowing. A practical test is to cut or break open a certain percentage of seeds from a representative sample; if in good condition the interior of the seed will present its natural firm consistency. The surest test, however, is to sow a counted number of seeds of a representative sample in specially prepared pots or beds under shelter, or on wet flannel or blotting-paper under cover. The proportion of seeds which thus germinate will afford proof of the quality of the seed. It is a good plan when seeds are of doubtful quality to soak them in hot water previous to sowing; very often this may add 20% or more to the rate of germination which would otherwise be obtained. (See *Vitality of Seeds.*)

Acclimatised Seed. This term is applicable to seeds of any introduced and acclimatised plant, but in India it often refers to " English " annuals and vegetables which thrive sufficiently well to produce seed capable of yielding satisfactory crops. It has sometimes been found that in some cases such seeds give better results, at least for a time, than imported seeds. Certain flowering annuals produce good seeds in the hill districts in the tropics, but seed of " English " vegetables grown here is seldom worth saving. As a general rule, cultivation in the tropics has a deteriorating effect on the quality of all flowering plants and vegetables from temperate climes. Therefore, imported seeds and fresh strains usually give the best results, and these are easily procured fresh from nurserymen in temperate countries.

Seeds of Aquatic Plants (water-plants), such as *Nelumbium*, *Nymphaea*, *Victoria regia*, etc., should be sown in clayey soil in pots submerged in shallow water. The pots should be raised on bricks or such-like supports, so as to bring them close to the water surface, thus securing greater warmth from the sun's rays than if placed deeper. Shallow still water is always the warmest.

Fern Spores should be sown upon fine sandy loam in well-drained pots or boxes. The spore-cases with fronds should be gathered before they have burst, and the soil sterilised by pouring boiling water over it, afterwards scattering the spores over the surface. The box or pot in which these have been sown should then be stood in a saucer of water, with a pane of glass placed over the top. Instead of separating the spores from their cases (*sporangia*), fragments of mature fronds may be laid on the surface of the prepared soil, when the fine spores will drop out. Neither covering with soil nor watering is required, it being sufficient to keep the vessel in which the pot is placed filled with water, as already described.

Orchid seed. (See *Orchids.*)

Propagation by Cuttings. This is, with the exception of seeds, the commonest method of propagation, and has the advantage of reproducing the characters of the parent as if the cutting were still a part of it, whereas these are not always perpetuated from seed. In the tropics, a very large proportion of plants and trees may be readily propagated by cuttings, provided these are inserted in damp soil during the rainy season. Some species, as Dadap (*Erythrina lithosperma*), *Gliricidia*, etc., strike root so easily that if stems or branches are used as fence posts they will rapidly develop roots and sprout into leaf and form trees. In other cases, however, as with species characterised by hard wood or hollow stems, it is difficult, if not impossible, to induce cuttings to strike root. For successful propagation by cuttings, the following conditions are important: (1) firm and sufficiently ripened shoots from which the cuttings are taken; (2) a suitable rooting medium composed of a light porous sandy soil, or fine, wet sand only; and (3), if possible, a higher temperature with closer atmosphere than those in which the plants grow normally.

Cuttings should have the soil firmly pressed around them. It is believed that they strike root more readily if inserted in the ground in a sloping position instead of erect, and gardeners as well as planters invariably practise this method in planting cuttings of general ornamental plants or field crops, as Cassava, Sugar-cane, hedges, etc. The explanation probably is that the cutting is thus more firmly fixed in the ground, and that there is less evaporation of moisture from the buried end.

Preparing Cuttings. The end of the shoot to be in the ground should be cut across with a clean slanting cut, through or just below a node or leaf-bud. The lower leaves should be cut off, leaving 3 to 4 eyes or buds to be under the soil when planted; the upper leaves, if of a large size, may be reduced to half. The best size for a cutting depends upon the nature of the plant. In hard-wooded species the cuttings are best small, with the buried ends split a little way up; but with soft-wooded kinds it is necessary to take rather large cuttings with a certain amount of firm woodiness. Cuttings of young, succulent, immature growth are liable to decay. Conifers and lactiferous plants will, it is considered, strike best if the lower end of the cutting is plunged into almost boiling water, the effect being to prevent the resin or latex from forming a hardened mass at the end. Some cuttings succeed better at one season than another, and the most suitable period can only be ascertained by trial. Generally speaking, however, cuttings will strike best at the commencement of the active growing season.

In taking cuttings of plants which are grown for their fruits or flowers, the upper shoots should be chosen, as it is well known that these are more productive and yield earlier crops than those obtained from the lower shoots, *e.g.* Pepper, Cubebs, etc. Similarly with flowering plants, cuttings taken from near the ends of the shoots will flower early and in a comparatively small state. Thus, plants raised by cuttings from the flowering shoots of the climber *Camoensia maxima*, which usually takes several years to attain a flowering state if raised from seed, have been found to blossom at Peradeniya in the nursery-bed when only about 16 in. high.

Although most kinds of cuttings may be propagated in a nursery bed of fine, sandy, moist soil under shade, others require special conditions, as in fine sand under glass. In glass-houses, where artificial heat and moisture are under control, and bell-jars for covering the cuttings are available, certain kinds of cuttings may be made to strike root which refuse to do so by ordinary means. The bell-jars prevent excessive evaporation and maintain a warm and moist atmosphere around the cuttings. Cuttings will strike better when placed against a porous substance, as the inside of a flower-pot partially filled with sandy soil or sand only. This fact has lately been taken advantage of in establishing a low hard-wooded plant, *Malpighia coccigera*, as an edging to some of the drives and paths in Peradeniya Gardens, where cuttings planted against the edging tiles struck root readily and formed an excellent dwarf edging, not unlike Boxwood of cooler climes.

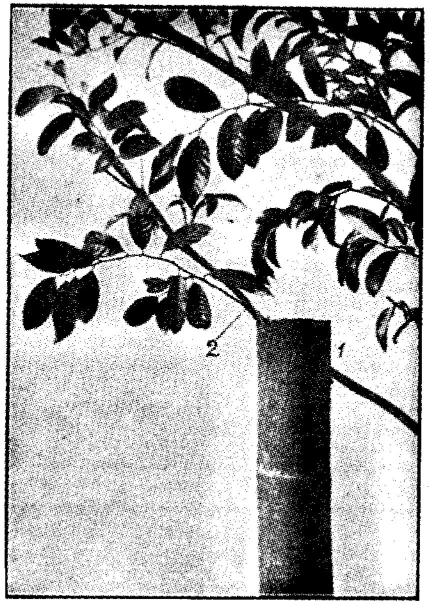
An effective method of striking obstinate cuttings is thus: Fill a flower-pot half-full of sand and soil; insert cuttings of a length sufficient to reach, within a little, the rim of the pot; sink the pot in the earth, and cover with a pane of glass. Another method: Procure a large flower-pot; in the bottom, place large loose pieces of brick, just so high that a small flower-pot placed inside upon them may have its rim on the same level as the rim of the large pot. Fill in the space between the pots with dry sand or earth. Then fill the inner pot with pure sand, and there insert the cuttings. Take another pot just of a size that when inverted it may fit in on the earth between the rims of the large and small pots; break out the bottom, and lay over it a piece of window glass. Water the cuttings as they require with

tepid water, allowing none to fall on the earth between the pots. When condensation of moisture takes place on the glass, merely turn it over. Fine river sand, kept moist and under shade, is an excellent medium for striking cuttings or for layering. (See *Sand.*)

Striking Cuttings in bottles filled with water is sometimes practised with ornamental plants, *e.g.* Crotons, Panax, etc., and with but little trouble is often successful. The essential conditions are: (1) cuttings to consist of the ends of young vigorous shoots; (2) capacious, opaque or shaded bottles; (3) water to be changed often to avoid its becoming foul, replacing it with tepid water when changed; (4) protection from wind and direct sun. Aquatics, or plants adapted to growing in water, can usually be multiplied by means of cuttings kept in water or mud.

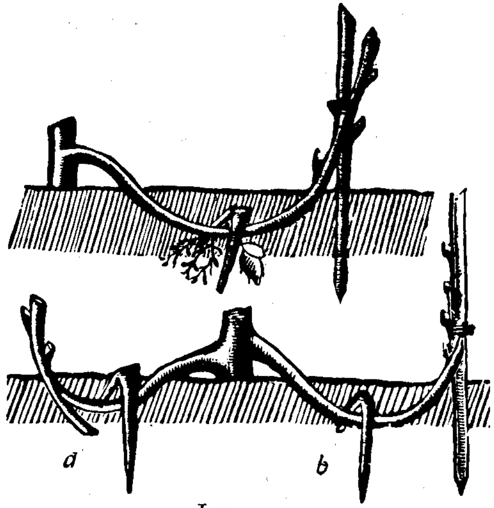
Cuttings of Cacti. Striking cuttings by partial drying in the sun is sometimes effected in the case of Cactus and similar succulent plants. Sections of these if placed on dry sand will, when become partially shrivelled, produce roots, whereas if placed in moist soil in a freshly cut condition they are liable to rot.

Propagation by Layers. When propagation by cuttings fails, layering may be resorted to, the latter, though a slower process, being generally a more certain method. The usual procedure is as follows: select a branch of ripened wood that will bear being bent down to the earth without breaking; cut the branch half-through with a sharp knife just under one of the leaf-buds, towards its extremity, passing the knife upwards, and slitting the branch about an inch or two up. The slit piece, with the leaf-bud at its extremity, called the "tongue," should be kept open by inserting a small pebble. Bend the branch down, and where the tongue falls remove the earth to the depth of 2 or 3 in.; the tongue portion is held down and secured in position by a forked peg, then covered over with a mixture of fine sand and leaf-mould. This must be kept shaded and moist, and may be protected by an inverted flower-pot or other means.



Layering Shoot of a Tree.

A bamboo about 5 feet long is fixed in the ground. The top end, through which a slit (1) is made for the layered branch (2), is filled with fine soil, which is kept moist.



Layering.

Showing shoot (*a*) tongued, and (*b*) pegged down.

Various modifications of this method may be adopted to suit different plants or trees. When the branch to be layered is too rigid to bend down, it may be made to pass through a broken flower-pot or other receptacle, the latter being filled with a mixture of sandy loam and placed on a support. Or a stout bamboo stem may be fixed in the ground, with the top end slotted and partly filled with soil, the layered branch being passed through this and, if necessary, held in position by being tied firmly to another bamboo fixed near it for support. Another simple method is to pass the branch through two half-round tiles, the space between these being filled with fine soil as above, and the ends with moss or fibre to prevent the soil running out; the tiles are then tied together, and the whole watered regularly.

Gootee-layering or Marcottage, a form of layering or ringing, practised in India and China from early times. It is adopted in the case of trees which are difficult to propagate by cuttings, or to which other methods of layering cannot easily be applied. The *modus operandi* is as follows: select a firm healthy branch with well-ripened wood; immediately under a leaf-bud or node make a slanting deep cut upwards, placing a small stone or a piece of stick in the groove to keep it slightly open. Round this apply a ball of adhesive soil, holding it securely together with coir fibre, tow, or moss, bandaging all firmly round the branch. A little above this hang an earthenware pot, and through the hole in the bottom of the latter draw from within a piece of thin rope; a knot tied at the end of the rope should fit tightly against the hole inside the vessel. The rope, secured by its knotted end within the pot, is carried on at full stretch and coiled round the gootee. By this means the water with which the vessel is kept supplied oozes slowly out, along the rope and around the bandage of earth, which is thus maintained in a moist condition. In from 3 to 4 months, according to species, young roots should be seen protruding through the gootee, when the branch may be severed from the parent tree and potted, or planted where intended to grow. The operation should be carried out in the wet season, commencing when active growth in the tree begins.

A modification of the gootee method is to place a piece of thin tin plate, folded in the shape of a funnel, round the branch in which a slit has been made. This is filled with moss or soil, which is kept moist by a drip from a bottle of water inverted and fixed above, with the cork pierced so that the water can drip slowly through and on to the branch.

Gootee Method of Layering.

The suspended bamboo contains water.

Ring-barking, in which a ring of bark is removed from a stem or branch which it is desired to propagate, is also sometimes adopted as a means of propagation, the bared portion being bandaged with a ball of earth as above described. (See *Pruning.*)

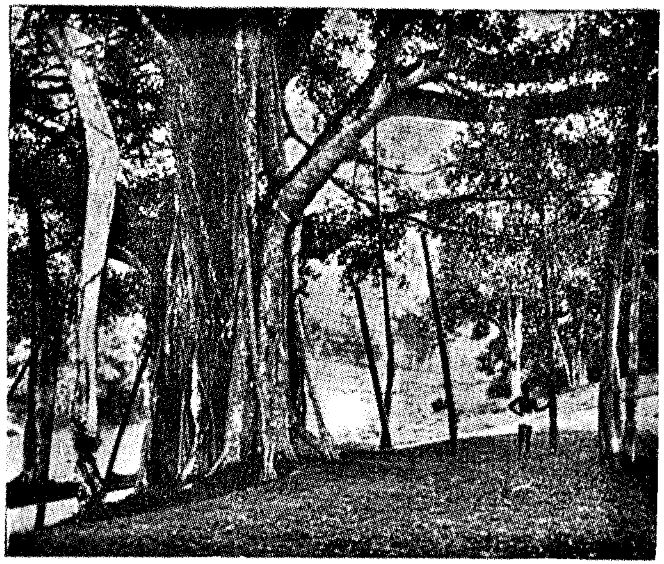
Propagation by Suckers. A sucker is a stem or shoot which springs from a subterranean portion of a plant or tree. Two kinds of suckers may be distinguished, namely *root-suckers*, which arise from adventitious buds on the roots, and *stem-suckers* or *ratoons*, which spring from the base of the stem, *e.g.* Pineapple. The former can be severed from the parent plant and removed with roots attached, *e.g.* Bananas (Plantains) and Bread-fruit. *Stem-suckers* are sometimes called "gourmandisers," as their growth is at the expense of the part of the plant above them. Plants which have been heavily pruned or pollarded often produce stem-suckers freely. The latter, when required for propagation, may be encouraged to produce roots by partly severing them with a deep cut, and then bandaging them up with some loam, which should be kept moist.

Propagation by Leaves. Many succulent plants, as Begonias, Gloxinia, Bryophyllum, etc., may be increased from leaves. The latter, if placed on a moist

surface of light sandy soil, and kept in position by being partly buried or held down with small wooden pegs, will produce buds at the margins which will develop into plants.

Propagation by Eyes. Many plants, especially those of a succulent nature, may be propagated readily by eyes or buds. The method is simply to take a plump shoot or stem on which there are buds not yet developed; cut this in a slanting direction into short lengths, about ½ inch above and below the bud. The pieces, having at least one eye or bud upon each, are planted in a pot or box of fine sandy soil, with which they should be just covered, being firmly pressed down. They should be kept moist and shaded, and covered with a sheet of glass.

Propagation by Roots. Some plants (*e.g.* Camphor) may, when other methods fail, be increased by cuttings of the roots, these being inserted in a sandy mixture of leaf-mould, etc., and kept damp and shaded. Aerial roots, developed from the upper limbs or branches of species of Ficus and other trees, may sometimes be used as a means of propagation. When these reach the ground they at once fix themselves in the soil, and in a short time form stout independent columns or trunks, affording support to the parent tree and thus prolonging its life; or they may be severed, and thus become independent trees. A method of inducing the aerial roots of certain species of Ficus to reach the ground and strike root is as follows: Long bamboo stems (preferably of the Giant-bamboo) are split into two, the transverse divisions being cut out; the two halves are placed facing each other round the aerial root and tied together at intervals, the lower ends being securely fixed in the ground. The top end is filled in tightly with moss to prevent the ingress of rats or squirrels, which are apt to damage the young roots.



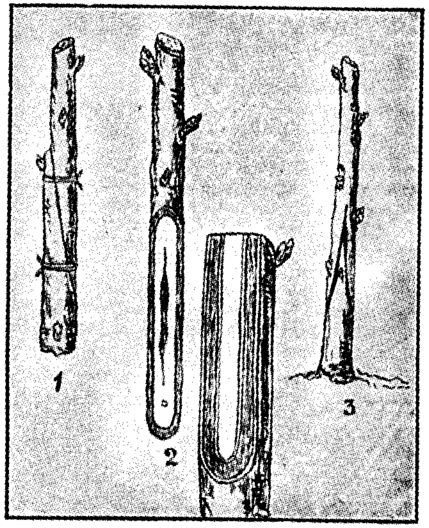
Ficus altissima.
Showing propagation by aerial roots.

Division of Root-stock. By this means plants which grow in clumps, or have a fibrous or tuberous root-stock, as herbaceous perennials, are easily multiplied. "Division" consists in separating portions of the main plant, each portion bringing with it some of the stems or buds as well as roots; if planted under suitable conditions, either in pots or in the field, these soon become established and form new clumps. To many plants of this nature the process of dividing and replanting each year is beneficial rather than otherwise, as if left undisturbed for a long period the soil becomes impoverished and the plant more or less exhausted. Orchids, many grasses, and herbaceous perennials are generally multiplied by division.

Propagation by Bulbs, Corms, and Tubers. Bulbs or tubers may appear on plants either underground, or on the stem or branches above ground. In some Yams (*Dioscorea*) both underground and aerial tubers are found on the same plant. A bulb is composed of either modified leaves in the form of scales, as in *Lilium*, or of the thickened bases of leaves folded round each other, as in the onion and *Crinum* ("Tolobo," *S*). *Bulbil* (a small bulb) is applied to *aerial buds* when they resemble small bulbs, as in *Agave, Furcraea,* certain ferns, etc. Sometimes

such bulbils are produced in large numbers (*e.g.* Sisal-hemp), and function as seeds as a means of reproduction, the seeds themselves being usually abortive or infertile. These bulbils, if planted in a nursery, will rapidly grow into large plants. A *corm* is a short, solid, conical tuber or a modified underground stem, from which "offsets" or "eyes" arise from the upper surface as buds, which are a means of propagation, as in Caladiums and other Aroids. A *tuber* is a thickened rhizome or underground stem, bearing buds or node-like scars, examples of which are Yams, Sweet-potato, Arrowroot, and Artichoke. Propagation of these is readily effected by portions of the tubers. The fleshy subterranean growths of the Dahlia are not true tubers, but enlarged succulent roots, which do not bear buds.

Propagation by Runners, Rhizomes, etc. This natural mode of propagation is well seen in the strawberry plant and in many "running" grasses and sedges, *e.g.* Doob-grass, Nut-grass (*Cyperus rotundus*), etc. A slender branch is sent off from the base of the stem, creeps along the ground, and at its end produces a new plant. Some plants have underground stems (*rhizomes*), which root along their under surface and develop new plants from buds on the upper, as is characteristic of the Ginger family, Iris and others. *Crowns* are a means of propagation in the case of pineapples, a prolongation of the main axis forming a tuft of leaves at the top of the fruit.



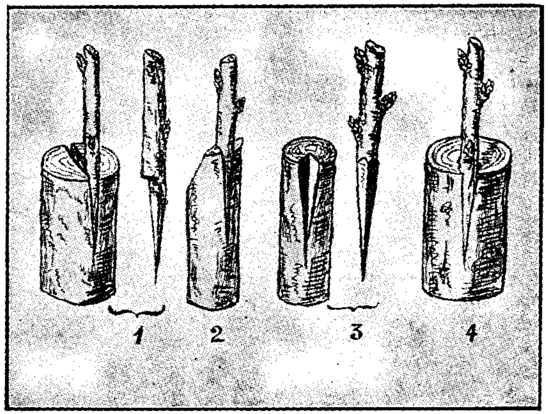
SHOWING FORMS OF GRAFTING.
(1) "Ordinary-" (2) "Whip-" (3) "Saddle-" grafting.

Grafting consists in placing together two cut surfaces of parts of the same or of different plants in such a way as to cause them to unite and grow together. The plant on which the graft is inserted is called the *stock*, and the part inserted the *scion*. The action of the one on the other is in some cases very marked, sometimes producing what are called "graft-hybrids." Fruit-tree grafts may grow freely on a certain stock but scarcely bear any fruit, whilst on another stock they produce abundant crops; therefore the selection of suitable stock is important. The possibilities of grafting are of the greatest importance in horticulture, and through its medium stock of valuable trees, etc. may be raised when other propagating means fail. Among its other advantages are: the good qualities of a selected variety are retained in the scion; fruit trees can be multiplied and brought into bearing early; in some cases the two sexes of dioecious trees may be brought together on one stock, thus ensuring the pollination of their flowers. In Ceylon, however, as in most tropical countries, grafting is seldom practised.

Scion and Stock. Certain conditions are essential for the success of the operation of grafting. The scion and stock should have a natural affinity, either as varieties, species, or genera of the same natural order; they should also be similar in natural vigour. The operation should be carried out in the shade, in moist, growing weather, and the parts protected from the sun until the union is complete. In all cases it is necessary to exclude air from the graft by covering it with grafting-wax or clay bound round with matting or fibre. A fundamental principle is the necessity of forming a direct contact between the cambium or formative tissue, under the bark, in both the scion and stock, without which contact no union can

take place. Different methods of grafting may be practised, according to the size and variety of the subjects, and each method may be varied to some extent as may be desired. The following are the modes most generally employed :—

Whip or Tongue Grafting is one of the best methods and is extensively practised in cool countries. The stock is cut in a sloping direction, just above a node. The scion is then similarly cut through obliquely; a thin tongue is cut in this in an upward direction, and a corresponding cut made in the stock; the scion is fitted into the latter so that the inner barks of stock and scion come in contact with each other. The graft is then bound firmly and covered with clay or grafting wax.

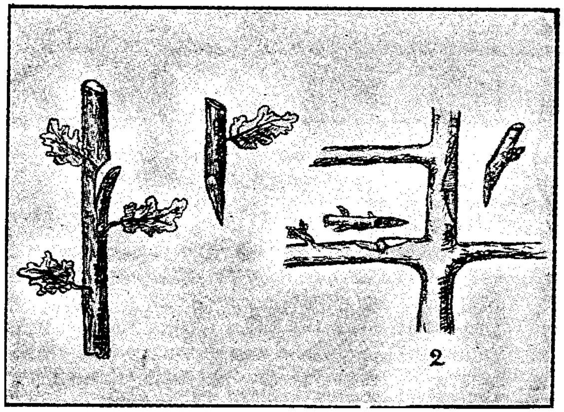


Different Forms of Grafting.

Graft-Budding. (See *Bud Grafting*.)

Saddle Grafting. In this the stock and scion must be of nearly equal thickness; the former is cut sloping-wise on each side, like a wedge, so as to allow of it fitting accurately into a corresponding notch made in the scion. This method is suited to shrubs and young-wooded plants.

Crown or Rind Grafting is applied to trees of considerable size. A scion about 6 in. long is selected; the lower half is cut in a sloping direction, and the notch or shoulder thus formed is made to fit on top of the stock. A slit is then made in the bark of the stock and, the two sides being carefully raised from the wood, the scion is inserted between the latter and bark. This can only be done at the commencement of the growing season, when the bark and wood easily separate.



(1) Herbaceous Grafting, (2) Side Grafting.

Side Grafting consists in inserting scions into the branches or sides of the stock, without cutting away the head of the latter. It is useful for supplying, where deficient, a branch or stem to any part of a tree. The scion, being splice-cut and thinned out, is inserted under the bark, the union being bound up and covered with clay or wax.

Grafting by approach, Inarching, or Siamese Grafting (from the Siamese twins) is an excellent method and easy to perform, of which natural examples may sometimes be seen in the jungle. It is specially suited to the tropics, and is successfully applied to Mangoes and other fruit trees. The stock in this case may be grown in a pot or bamboo, so as to be easily movable, or planted close to the scion. In the case of a large tree which it is desired to propagate in this way, a temporary platform may be erected under it, upon which the stock-plants are placed in pots; the shoots of the

tree may thus be easily bent down to reach the stocks. The mode of procedure is to remove an exactly similar portion of wood from both stock and scion; both these are then brought together and carefully fitted and secured with tying material and bandaged. When the parts have united, dissever the scion from the parent plant below the bandage. The grafted plant must afterwards be kept in a shaded place until it has commenced active growth, and stock and scion have become thoroughly incorporated.

Herbaceous Grafting is sometimes adopted for increasing in size individual plants of a herbaceous nature. By its means the Melon, for example, has been grown successfully upon the Cucumber, the Tomato on the Potato, etc. The stock and scion being nearly similar in texture, the former is carefully split, and the scion prepared, wedge-shaped, and inserted rather deeply, allowing the barks to coincide, as in all other methods. Tie with worsted, cover the cut with grafting-wax, and shade from the sun.

Budding is a form of grafting which consists of taking an "eye" or bud with a small portion of bark attached from a young branch, and inserting it in a corresponding cut made in the stem or branch of another plant. It is essential that the sap be in active circulation, so that the bark may readily become detached when lifted from the wood. This condition is found to be most marked where distinct seasons of growth or "flushes" occur. In equatorial regions, where the seasons are not so marked as in temperate countries, the operation of budding is not always successful. "In the upper provinces of India," said Firminger, "budding may be performed with great facility at two seasons of the year; but for some reason I am unable to explain I have not found such in the vicinity of Calcutta, where budding can so seldom be performed with success that it is rarely or never attempted."

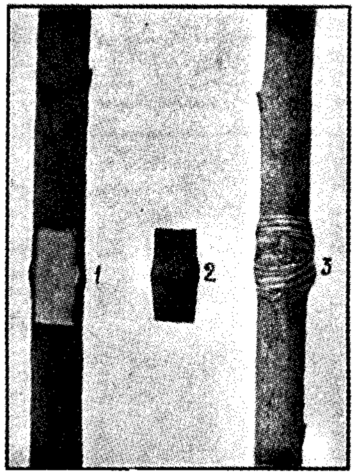
Inarching or "Siamese"-Grafting. The junction is exposed to show the tie before bandaging up with earth, etc.

The same remarks apply to some extent to other parts of the tropics, not, however, because the operation is difficult to perform, provided the necessary conditions are observed. Cacao has been successfully budded in the West Indies, and Hevea rubber in Ceylon, Java, etc.

There are various forms of budding, each being better adapted to particular circumstances, as *Shield* or *T-budding, Flute* or *Tube budding, Annular* or *Ring budding*, and *Patch* or *Graft budding*. The first-named form is the one chiefly practised for roses and fruit trees, and is performed thus: Select a shoot well furnished with plump dormant buds from the plant desired to be increased; cut off the leaves at half the length of the leaf-stalks. Remove a bud from the shoot by entering a knife ½ in. below the bud, between the inner bark and the wood, sloping the knife outwards above the bud. The small portion of wood taken with the bud is carefully removed with the point of the knife. In the bark of the young shoot in which the bud is to be inserted, make an incision in the form of a "T"; raise the bark carefully, push the bud gently into the opening, bind it securely with tape and budding wax to exclude air, leaving only the point of the bud exposed.

Dull cloudy weather and morning or evening should be chosen for budding, and the operation must be performed as quickly as possible, as both bark and bud are injured if exposed to the air for any length of time. Special knives are made for the operation of budding.

Patch-Budding or Bud-Grafting is sometimes practised with success in the propagation of the Mango, Hevea, etc. Seedlings 2 to 3 years old, with stems about the thickness of one's little finger, are selected for stocks, which may be either growing in pots or nursery beds. A rectangular piece of bark is removed from the stock, and in its place is inserted a piece exactly similar in shape (the *scion*) with a bud in the centre, taken from the variety or clone which it is desired to propagate. Full and well-formed buds from matured and healthy shoots, not less than 2 years old, should be selected. Precision in fitting the bud-bark with the incision in the stock, prevention of the admission of air and water between the scion and stock, and shade from the sun's direct rays are important factors for success. The bud-wood should be kept in a vessel with water so as to keep the buds and bark as fresh as possible until required. Grafting-wax should be smeared over the edges of contact, and the graft then tied firmly with strands of bast, or preferably grafting-tape, or strips of cotton dipped in melted paraffin-wax. If the plants are not in the shade, a shield of tin or stout paper should be fastened over the graft to protect it from the sun. After union of stock and scion has taken place, which should be in 3 to 6 weeks or later, according to species, the bandaging may be removed, and the stock pruned back. (See *Hevea.*)



Bud-Grafting or Patch-Budding. Showing patch with bud (2) removed from (1); 3, patch with bud placed and tied on stock, from which a similar piece of bark has been removed.

Grafting-clay is a composition used instead of grafting-wax for covering grafts for the purpose of excluding air and moisture until a union of the stock and scion is effected. It may consist of two parts of clay and one of cow-dung, which should be beaten together and thoroughly mixed until of the consistency of fresh putty, some time before it is required.

Grafting or Budding-wax is employed chiefly for budding, especially for graft- and patch-budding. To make grafting-wax, take: Resin (crushed), 4 parts by weight; beeswax, 2 parts; tallow, 1 part. Melt in a metal utensil, and stir thoroughly. Melted paraffin-wax will also answer the purpose to some extent.

Grafting-tape. To make grafting-tape, procure ½-in. cotton tape, or tear narrow strips of cotton. Soak these in the grafting-wax while in a melted state, and afterwards spread out to dry. As a substitute for grafting tape, take strips of thin pliable fibre, as may be obtained from the inner bark of *Hibiscus tiliaceus* or other species. Or the prepared raffia tape of shops may be used.

NURSERIES

A necessary part of the equipment of a garden or estate is a nursery for the propagation of plants, whether for garden or field purposes. The essential points of a good nursery are: shelter from wind, a plentiful supply of water, light shade, and fine, loose, well-drained, loamy soil. On an estate, a sheltered hollow with a stream running through should be selected as the most suitable site for the purpose. The ground should be cleared of brushwood, and rough stones, roots, etc. removed, the soil being trenched or dug deeply and formed into beds of uniform level. The beds may be made of any convenient size, but for facility of working they should not be broader than 3½ or 4 ft., with an alley of about 15 in. left between them.

It is customary to raise the beds a few inches above the ground level, which is advisable in low or wet ground, but in a locality subject to a limited rainfall, or in sandy soil, it is best to have level or even slightly sunk beds. A high bed is liable to get damaged by heavy rain, exposing or washing away the seeds, etc., while a low or sunken bed retains moisture and affords some shelter for young plants. (See p. 202.) The surface soil must be brought to a fine tilth and freed from stones, especially for seed-beds. No cattle manure should be mixed with the soil, unless it be in a thoroughly decomposed and powdered state; alluvial or loamy soil, with some sifted leaf-mould and fine sand added, forms the best medium for germinating seeds as well as for striking cuttings, layering, etc. Temporary shade for nursery beds must be afforded. This is easily provided by fixing forked sticks about 2 ft. high, alongside the beds, light bamboos or other sticks being placed over these lengthwise and across, while cadjans or other leaves suitable for shade can be laid on the top and regulated or removed as required.

Nursery or Propagating Sheds. In the hill districts some protection from wind and rain is usually indispensable. A serviceable shelter may be afforded by erecting a half-span roof of thatch, either over the beds where formed, or in a sheltered corner specially set apart for propagating purposes. The roof should be about 4 or 5 ft. off the ground at the back, about 6 ft. in front, and facing the morning sun. Such structures are also useful for the cultivation of certain crops, as Tomatoes, Cucumbers, Violets, etc., which thrive best under partial protection.

Propagating Pits. A useful means of propagation in the tropics, especially during dry weather, is a pit dug about 3 ft. deep in a sheltered corner, being covered over with palm leaves or other temporary light shade. A layer of sand may be placed at the bottom, on which pots, etc., may stand. By maintaining in this a moist, even atmosphere, cuttings may be encouraged to strike root, hard-shelled seeds to germinate, and plants in a backward state to form new growth. At the higher elevations, more permanent pits may be built, with glass-covered roofs. (See *Plant Houses.*)

PLANT BREEDING AND SELECTION

The term plant-breeding is applied to the improvement of plants by producing new strains, whether for economic or ornamental purposes. The results, upon which the profitable cultivation of many crops or races of plants depends, are of the greatest importance to the planter, farmer, or gardener. The process is based upon the intelligent selection of desirable strains or varieties, and the improvement and *fixing* of these by hybridising or crossing. The latter operation, briefly stated, consists in transferring the pollen (male element) from the flower of one plant to the pistil (receptive organ) of another of the same or closely related family. When practised with skill upon species or varieties of specially desired characters, valuable new races may be evolved. Most of the choicest flowers of the garden, and the most luscious and prolific fruits and vegetables have originated in this way, being perfected with the aid of high cultivation and careful selection. (See *Plant Life.*)

Until comparatively recently, the possibility of producing a hybrid was considered to be confined to plants of different species belonging to one genus, it being generally believed to be impossible to produce a cross between different genera. Now, however, we have bi-generic and multi-generic hybrids, and new generic names have been created for them; *e.g. Citrange,* a cross between a citron and an orange, and *Plumcot,* a hybrid between the plum and the apricot. Great advances have been made particularly in the bi-generic hybridisation of orchids, so that we are now familiar with such bi-generic names as *Odontioda* (a hybrid between Odontoglossum and Cochlioda), *Miltonioda* (a hybrid between Miltonia and Cochlioda), *Vuylstekeara* (a multi-generic hybrid between Miltonia and Odontioda), *Laeliocattleya,* and others. (See *Selection and Saving of Seeds.*)

Mendelism. The law of heredity, known as Mendel's Law or Mendelism, was discovered in the sixties of the last century by the Abbé Gregor Mendel. It is the basis of the study of heredity, and is of great value in

scientific plant-breeding. Previously all breeding or cross-breeding was effected largely without any certainty, and although as a general rule the peculiarities of the present generation might reasonably be expected to reappear in the progeny, what would actually happen could only be guessed at beforehand. Mendel conceived the idea that the puzzling results of cross-breeding must be governed by some settled law, and therefore set himself to investigate it, starting experiments on the simplest lines he could conceive.

He selected the various forms of the edible or garden pea, for the following reasons : *Firstly*, the flowers are so constructed that from the outset their anthers and stigmas are protected from outside pollen (which would, of course, produce unwished-for crosses) by being enveloped in the keel of the flower; by opening this keel before the flower was fully grown he could extract the unripe pollen-bearing anthers and insert the ripe pollen he desired to use, thus ensuring the desired cross. *Secondly*, these plants show definite and distinct characters, such as differently coloured flowers and variously coloured and shaped peas as well as pods. *Finally*, as they are annuals, a fresh generation could be obtained every year for the purpose of studying and tabulating results and starting fresh experiments. From these experiments Mendel discovered that the characters aforesaid fell definitely into two distinct categories, viz. (a) *dominant* and (b) *recessive*. A dominant character is one which appears to the exclusion of the other in the immediate offspring of a cross, the character which fails to appear being recessive.

The next discovery was that in a cross involving a dominant and a recessive character, all the offspring resembled the dominant one, so that apparently the recessive parent had failed altogether to act, even though it was this parent which bore the seed, for the same result occurred whichever was the seed-bearer. This first family of dominants being self-fertilised, the next remarkable result was that from their seeds arose two kinds of plants, viz. *dominants* and *recessives*, like the grand-parents, but always in the proportion of three dominants to one recessive when the average of a large number was taken. Here, then, was an obvious law, and long series of crossings and intercrossings proved that these characters, dominant or recessive, never intermingled absolutely, but only temporarily; so that when another period of reproduction occurred they were capable of dissociation or segregation.

"In the reproductive cells," says Dr. Lock,* "the dominant and recessive characters separate completely only on being represented in each cell. Such cells occur in equal numbers. When the reproductive cells unite, they do so at random, so that in the long run the combination DD, DR, RD, and RR are equally recessive. DD is a pure dominant like the dominant parent, and will always breed true to this character unless again crossed; the same applies to RR, DR and RD, which are crosses like the original cross; like it they are dominant in appearance, and their further behaviour is exactly the same. The apparent 3 to 1 ratio is thus explained. It is really a ratio of 1 : 2 : 1.—*i.e.* 1 D : 2 DR : 1 R. D and R breed true. DR makes up again like the original cross."

In Mendel's experiments the same ratios of "dominant" and "recessive" came out in all cases where sufficiently distinct characters presented themselves; and, above all, the same dominant prevalence in the first family was found to assert itself. This, for the plant-breeder, was in itself an invaluable discovery, since without this knowledge it often took years to establish a really reliable strain. He now knows that, instead of rejecting his crosses as failures, he has in them probably precisely the cross he desires, and has only to cross them again to obtain it in the succeeding family. Furthermore, he now knows exactly how to proceed in order to obtain a pure and constant strain on systematic lines. To those who may desire to pursue experiments on Mendelian lines, it is advisable to point out that it is only by doing so to a fairly large extent that this ratio becomes clear on averaging the results. The principle underlying the 3 to 1 ratio has been compared to that shown by mixing a large number of black and white shots in a bowl, three black to one white, and employing a blind man to pick out four at a time; the law of chance will then determine that the groups of four will average out three blacks to one white."

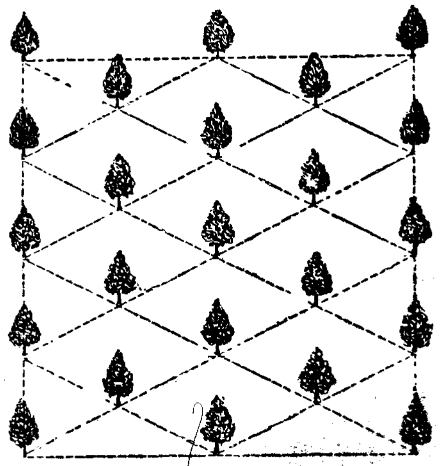
* *Variation, Heredity and Evolution*, by R. H. Lock, M.A., D.Sc.

CHAPTER VII

CULTURAL OPERATIONS

PLANTING

Planting, or the transference of plants, trees, shrubs, etc., from their pots or nursery beds to prepared places in the open ground where they are intended to remain and grow, may usually be done in the tropics at any time, except in very dry seasons (see *Climate*), the most essential condition being that the soil be in a moist, though not excessively wet, state. Thus in Ceylon, for example, planting operations may commence at the setting in of the monsoon rains in June and October, but should not as a rule be attempted during the months of January to March. Late in the afternoon is the best time to plant, and a good watering should, if possible, always follow, except perhaps in very wet weather. Care should be taken not to injure or double back the roots, which should be spread out evenly. As annual crops should be sown in drills, so all shrubs or trees that are cultivated as crops should be planted in rows, preferably on the quincunx system, in which the plants in each row alternate with those in the next in any direction.



Quincunx or Alternate Planting.

Lining. In the case of plantation or perennial crops, the ground is first marked out in lines at equal distances apart, pegs being driven in at regular intervals to mark the position of the holes. The latter should be dug by the side of the pegs, leaving each peg in position and always in the same direction with regard to the hole.

Holing. It is very important, especially in poor soils, that sufficiently large holes be made in the first place, for otherwise the plants are liable to languish and become stunted in growth. The proper size of the hole depends upon the nature of the plant or tree to be planted and on the character of the soil. For moderate-sized shrubs, the holes may be about 2½ ft. in diameter and about 24 inches deep, while for fruit and other trees they may be about 3 ft. deep by 4–5 ft. in diameter. In the case of large, deep holes, it is well to place a layer of broken bricks or stones in the bottom to form drainage, placing over this a layer of dry grass, straw, or coir fibre to prevent the drainage from clogging. The top soil taken out should be mixed with some manure or any well-decayed organic matter available, before filling it in again. Always remember that the top soil is the best and should not be placed at the bottom of a deep hole.

It is important that the soil be pressed firmly about the roots when the plant is being placed in position. In wet or cold localities, planting should be shallow rather than deep, with the soil well raised around the plant, so that when quite

settled the latter is slightly higher than the surrounding level; this avoids the risk of stagnant water accumulating round the young plant.

In dry or windy districts, however, and especially on steep land, it is advisable to plant rather deeply, leaving a depression around the plant in order to retain moisture and collect beneficial mulch. The good effects of this practice are seen in the customary method of planting Coconut seedlings in Ceylon, *i.e.* in deep holes only partially filled. The young plant is thus afforded beneficial shelter, its roots obtain a deep and firm hold of the soil, and the hole becomes filled up in course of time by the processes of weeding and weathering. (See *Use of Explosives.*)

Puddling Roots. An excellent practice, either in planting or transplanting, is to puddle the roots in mud immediately the plants are taken out of the ground for removal. A mixture for puddling may be made simply by adding water to some adhesive earth, and stirring it until of the consistency of thick paint. If the soil be too porous for the purpose, it can be made adhesive by adding cow-dung or clay. By dipping the roots in the mixture a coating adheres to them which has the effect of excluding the air, and therefore keeping them moist. This method is especially beneficial in the case of plants which have to be carried over long journeys, or are unavoidably out of the ground for a considerable time.

Transplanting. It is often necessary in gardens or on plantations to transplant shrubby plants or small trees, either to more suitable places or for the purpose of filling vacancies, or for replacing weakly plants. In the case of large bushes or spreading trees, it is advisable first to cut these well back, so as to reduce their foliage or transpiring surface, thus balancing the latter with the check received at the roots. Having well soaked the ground with water, dig a trench a few feet away in a circle round the tree or shrub, so as to leave a good ball of earth adhering to the roots. The size of the circle may be gradually reduced by using a fork carefully, so as to injure the roots as little as possible. Forking out the soil from below, the ball of earth with roots should be kept intact by means of sacking tied tightly round it. By means of planks placed slanting underneath, the tree may be slid out and safely removed. After cutting off any injured portions of the roots, fill in the hole with good soil, pressing or ramming it firmly around the roots as you proceed. Finish by giving a thorough soaking of water and placing a layer of mulch on the surface; fix supports round the tree to prevent its being shaken about by wind, and shade well until new leaves have developed.

Shading. In the tropics it is necessary to protect all young plants, on being first put out in the open ground, from the powerful rays of the sun, by means of some temporary shade. Even when well established, many plants are always liable to be injuriously affected by direct exposure to the sun during the hot dry season, and are greatly benefited by partial shade. For certain young seedlings, as Tobacco, vegetables, etc., it is sufficient to shade them for a few days after planting with any large leaves or fern fronds that may be at hand, these being fixed in the ground by their stalks and bent over the tender seedlings. Twigs or fern fronds which do not readily drop their leaves or leaflets when withered are the best for the purpose, as for example the pretty fern *Gleichenia*, whose wiry persistent fronds are especially suited for inserting slanting-wise in the surface of nursery beds. Plaited palm leaves, especially those of the Coconut (cadjans), afford useful temporary shade, these being loosely woven into a basket-like shape, which is placed over the plant and held in position by means of three sticks fixed in tripod fashion in the ground.

Watering. Though it is always best to plant in rainy weather, it is often impossible to follow the progress of the elements, and as moisture as well as shade is usually a necessary condition for newly planted plants, watering by artificial means must be adopted when the rain fails. A good plan is to form a shallow trough around the plant, filling this with water at intervals, and afterwards covering it up with earth. (See *Watering of Pot-Plants.*)

Tree-guards and Supports. Especially in public grounds or along roadsides or streets, protection of some sort is without exception indispensable to young plants which are intended to form shapely or ornamental trees. A fence of the "solid" or "male" bamboo forms a substantial protection for a time, as does also a circle of some hard-wood scantlings, with the lower ends tarred; but the most effectual and durable protection are iron tree-guards, preferably those in which the uprights are pointed at the top and bent outwards. In exposed or windy situations it is often necessary to support plants individually, especially those with slender stems, by fastening them to firm stakes or poles fixed in the ground. Such support should as a rule be provided at the time of planting, and care must be taken that the plant

does not chafe against it, and that the tie is not left on long enough to cut into the bark.

Planting Distances. The proper distances for planting vary, of course, according to the nature of the plants or crop, soil, and climate. As a general rule every individual plant or tree should be afforded sufficient space to allow of its healthy and profitable development. Such distances, in this work, are usually given under the respective crops, except where a repetition is unnecessary or impracticable, in which case the desired spacing may be inferred from the size of the respective species at maturity. When planting in rows, the latter should be at equal distances apart, and the distances between these should be greater than those between the plants in the rows, in order to facilitate working. The plan known as the *quincunx*, or alternate planting, is generally the best method of placing the plants, and is applicable to any spacing. In this (see fig. on p. 49) the plants in each row alternate with those in the row on either side, while they are also in straight lines in whichever direction looked at.

TABLE OF PLANTING DISTANCES

The following table shows the number of plants to the acre at distances of 1 to 50 ft. apart, and the area in square feet available for each plant:

Distance apart in feet.	Area for each plant in square feet.	Number of plants to the acre.	Distance apart in feet.	Area for each plant in square feet.	Number of plants to the acre.
1 by 1	1	43,560	15 by 15	225	193
1½ by 1½	2¼	19,360	16 by 16	256	170
2 by 2	4	10,890	17 by 17	289	150
2½ by 2½	6¼	6,970	18 by 18	324	134
3 by 3	9	4,840	19 by 19	361	120
3½ by 3½	12¼	3,556	20 by 20	400	108
4 by 4	16	2,722	22 by 22	484	90
5 by 5	25	1,742	24 by 24	576	75
6 by 6	36	1,210	26 by 26	676	64
6 by 7	42	1,037	28 by 28	784	55
7 by 7	49	889	30 by 30	900	48
8 by 8	64	680	32 by 32	1,024	42
9 by 9	81	537	35 by 35	1,225	35
10 by 10	100	435	37 by 37	1,369	32
12 by 12	144	302	40 by 40	1,600	27
13 by 13	169	257	45 by 45	2,025	21
14 by 14	196	222	50 by 50	2,500	18

For numbers not given in the above table, divide 43,560 by the square of the distance apart the trees are required to stand, in feet; the result is the number of plants required per acre.

PRUNING

The various modes of pruning, as practised for different crops or trees, are based on the same general principle, viz. the concentration of vigour into certain parts of the plant by the cutting away of other portions, either of the stem, branches, roots, or leaves. The object in view may be the production of a larger yield or better quality of fruits or flowers, straight clean stems (as in timber and rubber cultivation), twisted or bent stems (as for furniture making, etc.), wide spreading branches (for shade), or an abundance of young shoots and foliage, as in tea cultivation.

By means of pruning, trees or bushes may be induced to assume a form which will not only add to their productiveness, but also facilitate the harvesting or plucking of the crop. Trees should be encouraged when young to form an evenly balanced head, with the branches radiating regularly from the centre. The more upright and straight a shoot grows, the freer will be the circulation of its sap, and therefore, as a rule, the more active its vitality. The effect of pruning is analogous to that of manuring, and this fact is sometimes taken advantage of by "hard pruning" bushes which become stunted or "sick." Pruning may also be resorted to in order to rid plants of certain fungus diseases or insect pests. In the tropics, the practice of pruning is affected by the absence of a well-defined resting period, but the principles, generally speaking, remain the same. The pruning of fruit trees varies to some extent according to locality and species, and no hard and fast rule can be laid down (see *Fruit Culture*). The operation should be carried out as may seem necessary in individual cases, that is, usually, after crops have been gathered or flowering season is over. Periods of severe drought should be avoided for pruning of any kind.

In India a similar effect to that of pruning is sometimes produced by the crude practice of either stripping off the leaves, or subjecting the trees to a "severe thrashing," as in the case of unfruitful mango trees, by means of a long pliable bamboo. Although too crude to be recommended, the result of the treatment is to retard exuberant growth, and so induce fruitfulness. An old adage might thus be adapted:

A wife, a dog, and a mango tree,
The more you beat them the better they be.

Volumes of smoke, as from burning wood or rubbish, are regarded in some countries as a remedy for barrenness in fruit trees, for which also a form of ring-barking (which see) is sometimes recommended.

General Rules for Pruning. The following rules are of general application, whether for large or small trees:

(1) For fruit trees, thin out shoots or branches if too numerous, so as to allow free access of light and air; cut well back vigorous-growing shoots; remove all dead wood, snags, superfluous suckers, etc.

(2) Always use a sharp knife or saw, and cut in a slanting or upright direction, so that the cut end may throw off the rain; leave a smooth surface.

(3) In pruning for shape, cut just above a bud which points in the direction it is desired the new shoot should take.

(4) When cutting back lateral branches, always cut at a fork.

(5) In removing a large branch, saw it off roughly (cutting the underside first, and then the upper a few inches further from the stem than the first cut) a foot from the trunk, and finally saw off the stump left and plane the surface.

(6) Smear coal-tar over large cuts; otherwise the action of sun-heat may crack the wound, thereby allowing moisture to enter and enabling parasitic fungi to obtain a footing.

(7) When removing branches, especially large ones, avoid leaving snags; always cut a branch flush with the outside of the stem or branch from which the portion removed issues.

(8) In general, pruning should not be performed during severe drought, or when trees are in fruit, flower, or active "flush."

Pruning of Shade or Flowering Trees. The object in regard to the pruning of these should be to obtain a form which, while developing the natural beauty of the tree, will tend to prolong its life and usefulness. The longest-lived trees are those with a straight, erect, and undivided main central axis or trunk. An upright, evenly radiating system of branching, commencing from a height of about 6 ft. from the ground, is generally desired, and this may be induced by careful attention to the tree when young.

Collar Pruning, *i.e.* sawing off the main stem or stems at, or a little below, the surface of the ground, is sometimes resorted to when tea bushes become old and unproductive, or in order to eradicate a formidable pest. It differs from *cutting down*, which is more common, the bush in the latter case being cut at a height of from 6 to 10 in. In either case the operation should be carried out in the rainy season, and the bushes should be liberally manured some three weeks previously.

Thumb-nail Pruning. A term applied to the nipping off of the terminal young bud, as done by the thumb-nail and forefinger, being a form of pruning conveniently applied to tender plants. At one time it was recommended for young Hevea rubber trees, being adopted when the trees were about 6 to 8 ft. high, the object being to induce a more rapid increase in girth of stem and a branching top.

Root Pruning is sometimes employed in the cultivation of fruit trees with the object of counteracting a too luxuriant woody growth, which results in paucity of fruit. A trench is cut round the tree at a suitable distance from the stem, and 3 to 4 ft. deep; all roots met with are cleanly cut, and if a long tap-root is suspected of entering the subsoil it should be searched for, by careful undermining, and severed. In the north of Ceylon, where the climate is dry for the greater part of the year, the practice in regard to the Grape-vine is to remove the soil from around the base of the stem, cutting away some of the smaller roots. After exposure for a week or two the trench is filled in with manure, which is covered over with the soil previously removed. Similar treatment is applied in India to the Mango and other fruit trees. "This," said Firminger, "though apparently opposed to theory, is in fact more efficacious in practice, and the trees thus treated bear prodigiously." In the cultivation of fruit generally, the object should be to encourage the growth of fibrous roots near the surface, and prevent the development of strong woody roots into the subsoil.

Cavities in Tree-trunks. Very often, when a tree has been long neglected, the trunk becomes seriously injured by cavities caused by the decay of snags or branch stumps. With skilful pruning this can be avoided or arrested. The edge of the cavity should be cut smooth and even, and all decomposed matter in the interior carefully removed. A coating of tar should then be applied to the surface of the cavity, and the mouth plugged with a piece of well-seasoned hard wood securely driven into place, the outer end of the plug being then carefully pared smooth and tarred. Or the cavity may be carefully filled with a mixture of cement and tar. If cement alone is used it is liable to crack and form fissures.

Bark or Hide-bound Trees. It is believed that in some cases cortical or bark pressure becomes so great as to retard the growth of trees, preventing the normal formation of new wood. In temperate climes this unhealthy condition is considered to be indicated by the natural shedding of the leaves being impeded. Longitudinal incisions made in the bark, without removing any tissues, are supposed to relieve the bark pressure, being followed in due course by a natural increase in thickness of the affected stem.

Ring-barking, or ringing, are terms applied to the removal of a strip of bark, varying in breadth from a few inches to as much as 2 ft., according to the size of the tree, from near the base of trees which it is desired to kill by starvation. It is sometimes adopted for killing large or superfluous trees which it would be costly to cut down, or to season timber trees before felling, as in Teak forests. To be successful it must be performed during the period of greatest cambial activity, *i.e.* when the sap is up, as it is popularly called, and the cambium and bast layer must be removed as well as the bark. The direct effect of this is to cut off the downward flow of sap and food material from the leaves. Where trees are required for timber, the process of killing by ring-barking is considered to improve the quality of the latter. A form of *ringing* is sometimes adopted to hasten the ripening of fruits, or, as a last resource, to render unfruitful trees productive. The principle is also employed in vegetative propagation, as a means of inducing the formation of a callus on cuttings or layers.

Pollarding is commonly applied to trees which have become too large or ungainly, or for the purpose of retaining trees within certain desired limits of growth, as in the case of roadside trees. It is also commonly practised with shade- or green-manure trees among plantation crops, the loppings being employed for mulching or green-manuring. Briefly, the operation consists of cutting back the main stem at any convenient or desired height, also the branches periodically. In effect, it is applied to certain cultivated crops, *e.g.* Tea, Camphor, etc., in the process of harvesting.

CHAPTER VIII

GARDEN ADORNMENTS, LABELS, IMPLEMENTS, Etc.

Seats are always an essential part of the equipment of a garden, more especially in the tropics, and it is safe to say that much of the enjoyment of a garden may to a large extent depend upon them. Commanding views, overlooking terraces, spots of special interest, or under a shady tree—these are the kind of positions where seats should be placed to be appreciated.

The ground underneath the seat should be gravelled or paved, so as to avoid the discomfort of damp grass or the intrusion of land-leeches, ants, etc. The form of seat used may vary from a plain wooden bench to elaborate cast-iron designs. Rustic seats made of knotted branches, though sometimes admired, are generally uncomfortable. The most satisfactory and economical seats in Peradeniya Gardens consist of wrought-iron ends, with narrow strips of wood forming the seat and back. All seats, with perhaps the exception of rustic ones, should be painted, and this requires to be renewed at least once a year. The most suitable colour, for the low-country at any rate, is light grey, which does not become discoloured so rapidly as other shades. Both green and chocolate paints quickly lose their freshness.

Adornments. Gardens in the tropics are seldom embellished with such artificial adornments as statuary, beautiful vases, elaborate fountains, etc., such as are met with in temperate countries. Other and simpler devices, in the form of arbours, arches, and trellis-covered walks on which ornamental creepers or climbers may be trained, can, however, be adopted with very pleasing effect. Any adornments used should, as far as possible, take a practical form and serve a useful purpose; thus a fountain may be utilised for the growth of water plants, rearing fish, etc.; vases should be adapted to the successful display of ornamental plants; while pergolas may be made to provide cool shade as well as a means for the effective display of ornamental climbers.

Pergolas. A pergola consists of an archway, or a series of arches, over a walk, and may be formed of rustic stems, pillars of masonry, or iron framework on which climbing roses or other suitable plants are trained. A suitable pergola affords cool shade, and is especially agreeable in the tropics. It should for preference be on level ground, and is the most effective when straight, not curved; it may be of any length, but should not be less than about 7 ft. wide and 7 ft. high. A pergola in Peradeniya Gardens consists of a number of iron arches covered with different species of Aristolochia (" Fly-catching " plants), Ipomoea, Bignonia, etc.

Arbours may be of various designs to suit circumstances. A simple and cheap form may be made of iron framework, fixed in the ground by means of sections of bamboo, buried in the earth and then filled with concrete; wire-netting is fastened over the iron framework, and on this showy creepers are trained. Arbours made of woodwork, with the sides formed of rustic and knotted branches, and the roof covered with shingles, are very appropriate to the hill districts. Some pretty examples of these may be seen in Hakgala Gardens and Nuwara Eliya Park, Ceylon, being made of Rhododendron wood.

Visitors' Shelters. No public garden in the tropics should be without some structure that will provide shelter for visitors, and this should to some extent be made to combine ornament with utility. In Peradeniya Gardens, memorial structures, erected to the memory of past directors, serve the purpose of useful shelters to the public.

Fountains are well adapted to gardens in the tropics, where, during hot dry weather especially, the spray or rippling sound of water is particularly pleasant. The base of the fountain, while serving as a useful reservoir, may be turned to good account by cultivating various water-plants in it. (See *Adornments.*)

Vases for Gardens. Very fair imitations of outdoor vases may be made of cement, from given moulds. Good specimens of these may be seen in the Gordon Gardens, Colombo, where, being painted white, they are very ornamental, especially when filled with well-grown and suitable plants. The Sinhalese potters make earthenware urns on elaborate hollow pedestals which, though liked by some people, are very fragile and only suited to a verandah or other position under cover.

POTS AND OTHER RECEPTACLES

Pots. The Sinhalese potters can sometimes turn out very satisfactory pots to a given pattern, but those which they make on their own initiative are often ungainly and unsatisfactory, being either too deep and perpendicular, bulging in the middle, or disproportionately narrow at the base. Good pots should become gradually narrower from the top towards the bottom. If the sides are perpendicular, the plant with its ball of earth cannot easily be turned out without breaking the pot. Generally speaking, pots of large sizes should not be so deep as they are wide at the top; while in the case of small-sized pots the depth should equal or slightly exceed their top width. A very common mistake in Ceylon gardens is to use pots unnecessarily large, for these are obtrusive, as well as unsuitable for the healthy growth of plants (see p. 75).

Hanging Pots may be made in quite a variety of forms. The perforated kind, in which Maiden-hair ferns, Selaginella, etc., may be successfully grown, is perhaps the most effective. Those made of cement are ungainly, heavy, and devoid of porosity. Quite effective are some of the bottle-shaped earthenware urns, around which a layer of loamy soil is held in position by means of close wire-netting fastened on; into this dainty ferns and suitable plants are dibbled, and these obtain a constant and regular supply of moisture by absorption through the urn, which is kept full of water.

Bamboo Pots. Sections of bamboo, which may be obtained of various sizes, with the transverse division left in one end and a hole punched through it for drainage, make very useful pots for temporary purposes. They may also be used for propagating work, and the larger kind as receptacles for growing orchids, etc. For the latter purpose they should be cut into small shallow sections, several holes being made in the sides and bottom for aeration and drainage.

Horizontal Hanging Bamboos, Bamboo Vases, etc. Sections of the Giant-bamboo can be utilised in various ways for the purpose of growing ornamental plants, also as temporary " flower-vases " in corners of drawing-rooms, corridors, etc. As horizontal hanging " pots," single joints of any stout bamboo can be used very effectively. For this purpose, leave the division in each end intact, cut out one side to about one-third its diameter, and fasten two wires near each end for hanging; a few holes should be made in the intact (lower) side for drainage.

Tubs, either made for the purpose, or consisting of empty whisky or wine-casks cut into two, make useful receptacles for growing large plants, as palms, etc. Such tubs may be painted green with the bands white, or *vice versa,* and should be raised off the ground on bricks. An iron handle fixed to opposite sides of the tub will facilitate removal when necessary. A simple and effective form is the square " tub " or box made in four separate sides, which narrow slightly towards the base; these are fastened together at the corners by means of a couple of clamps on each, with pegs at both ends, and can be taken to pieces when desired. When painted white, with the clamps in green, these look neat and ornamental.

Tins and other receptacles are sometimes employed for growing plants in, but their use cannot be generally recommended, as, apart from their ungainly appearance, they are impervious to moisture. When, however, such makeshifts for pots are used, their appearance may be improved by painting them green with a white band at the top. A few holes should be made in the bottom, and some potsherds or small pieces of broken pots placed over these for drainage.

Clean Pots. Earthenware pots look best in their natural colour and when

kept clean and free of lichenous or mossy growth. To paint them green or other colour is, it need hardly be said, a mistaken idea of beauty and destroys their porosity.

Seed Pans are most useful in propagating work, whether for seed or cuttings. They may vary in size, but should not exceed 12 in. in diameter by about 3 in. in depth; if too large, they are less portable and more liable to be broken.

Seed boxes are almost indispensable, especially in the hill districts, both for raising seedlings under protection and for pricking these off afterwards before finally planting out. The boxes should not be less than about 3 in. deep, and should be provided with openings for drainage.

PLANT LABELS

The utility of and interest derived from a garden, especially a public or botanic garden, must to a large extent be in proportion to the use made of neat, legible labels, bearing the names of the plants, trees, etc., or other information concerning them. Labels should not, however, be made too conspicuous or obtrusive. Small plants may have small labels in proportion to their size, but large trees need not have unnecessarily large labels. The upkeep of labelling in tropical gardens is a matter of considerable difficulty, owing partly to the attacks of termites, which destroy most forms of dead wood, and partly to the liability of metal labels being stolen or becoming corroded. Various sorts and designs of labels have been adopted, and the following are some of the principal kinds in use.

Wooden labels are perhaps the most convenient form for ordinary purposes; they may be of any size and shape, can easily be altered to suit requirements, and are neat while they last in good condition. Those which are intended to remain in the ground should be of the hardest wood. Deal-wood labels in the tropics are only suitable for very temporary use, as for seed-boxes under cover. They should be planed and rubbed over with white-lead paint, as they are then easier to write on, look best, and last longer. Large, stout, wooden labels made of such hard woods as Pehimbiya (*Filicium*), She-oak (*Casuarina*), Iron-wood (*Mesua*), Palu (*Mimusops*), are employed at the Royal Botanic Gardens in Ceylon, for trees, shrubs, etc. These are painted black, and the name is printed in white zinc paint with a fine brush; the stem of the label is afterwards dipped in tar, and allowed to dry before being put out to the trees. An improvement on this form is to stamp the name on the smoothed surface by means of steel letter-dies, the impressions being then filled in with white paint.

Bamboo-splint labels. A splint of hard bamboo, with one end sharpened for fixing in the ground, and the other flattened and planed, makes a cheap and serviceable label. When writing upon it, first rub some flat-white paint on the planed surface, and use a soft lead pencil.

Lead labels are perhaps the best of permanent kinds, and are used extensively at the Botanic Gardens, Kew. Each consists of a piece of sheet-lead, about 3 in. long by 2 in. broad, with about ½ in. of one long side turned over to form a rim, below which 2 holes are pierced for suspending by wire. The letters composing the name of the plant, etc., are punched in with punch-type, the impressions being filled with white paint, and the surface afterwards rubbed over with an oiled rag.

Brick labels. To obviate the destructive effects of termites, brick labels, made to a given mould, have for many years been largely used in the Botanic Gardens, Ceylon. The top has a sloping, smooth surface, which is painted black, the name and other particulars being printed on in white paint. Though not durable, this type of label is comparatively cheap, and is also of course termite-proof.

Zinc labels. Narrow pieces of clear sheet-zinc make excellent labels for pot-plants, orchids, hanging baskets, etc., and are extensively employed in the Ceylon Botanic Gardens. They are written on with an indelible ink, which can be obtained ready-made. See *Indelible Ink*, below.

Sheet-iron labels. Strips of sheet-iron painted black, with the name, etc., written on in white, are often used for labels in India.

The "Imperishable Stratford" labels. These excellent labels are made in England to order, being obtainable in almost any size and shape, and may include any name, description, or notice as may be desired. The "Stratford label" differs

from the "Acme" in being made of white metal, with the raised letters in black. These labels are commonly employed in Botanic Gardens in India, Ceylon, and the West Indies. They may be kept in a legible condition by an occasional cleaning, followed by a coat of paint over the raised type. In order to effect this, mix some paint to the consistency of printer's ink; spread it out on a smooth hard surface, pass a rubber roller or squeegee over the paint and then over the raised letters.

The "Acme" labels are made of stout zinc, with raised letters on black ground. They are supported on stiff wire stems, or suspended by wire, or nailed to a wall.

Ivorine label is a composition of thick parchment-like substance of the appearance and consistency of ivory, and is now largely used for labelling pot-plants, especially orchids. It is of neat appearance, is said to be imperishable and unbreakable, and can be written upon by either pencil or pen, the writing being indelible, except when hard rubbed with soap.

Waterproof labels. For the temporary labelling of plants, etc., as in packing for transport, these labels are most serviceable and convenient. They are made of "manila" substances, with a parchment surface, and are easily written upon with ink or pencil.

Preservatives for wooden labels. Wooden labels should always have the part to be fixed in the ground treated with some preservative before being put out. Various compounds of creosote, copper sulphate, carbolic acid, etc., are used for the purpose, all with more or less success. Dipping the labels in boiling tar or oil, and then plunging them into fine dry sand or coal dust, has an excellent preservative effect. Charring the ground end of the label and then tarring it has a similar result.

Indelible ink for zinc labels. A solution of platinum bichloride (one tube of 15 grains to about 2 fluid oz. of water) forms one of the best and most durable forms of writing fluids for zinc labels. It can be used either with a red-ink nib or a hard pointed piece of palm-leaf petiole. Special writing fluids may be obtained from nurserymen, but when neither these nor the platinum chloride are procurable, a useful substitute may be made as follows: Dissolve 1 oz. salammoniac and 1 oz. verdigris in 6 oz. of water; stir well together and keep in a glass-stoppered bottle; shake before using. A strong solution of copper sulphate will also answer the purpose to some extent, but is less efficient.

GARDEN AND ESTATE TOOLS AND IMPLEMENTS

Though the number of tools actually required for a garden or plantation in the tropics is not large, there are many not generally known which would facilitate various operations in connection with garden or field work and prove a considerable saving of labour. The stock-in-trade of a garden coolie is often limited to a mamoty (kodali), watering-pot, and a sickle, and it is only at the expense of time and labour that he gets over the work with these.

The quality of the work done, however, is not all that could be desired. Of late years the number of useful and labour-saving implements for the farm and garden has been considerably augmented. Though many of these are obviously unsuited to the conditions of labour in the tropics, others are of easy application and effect a considerable saving of labour in addition to better workmanship. Needless to remark, it is true economy to employ the best and most suitable tools. Though the following list includes many that are not necessary for a small garden, all will be found useful for general field or garden work.

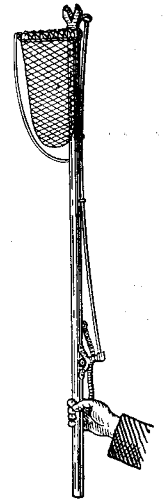
USEFUL TOOLS AND IMPLEMENTS

AND PURPOSES FOR WHICH THEY ARE MAINLY REQUIRED.

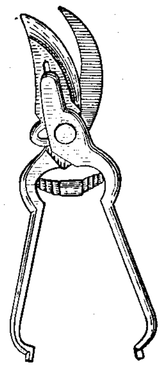
[*S* = Sinhalese; *T* = Tamil.]

Alavango or Crowbar. Digging holes, levering, etc.
Ant-exterminator. Fumigating ant-nests; very effectual.
Antipest or Knapsack sprayer. Fine fluid-spraying.
Averruncator. See Tree-pruner.
Axe. Porowa, *S*; Kodali, *T*. Felling trees, chopping wood, etc.
Basket, manure. Kooday, *S*. Removing manure, soil, gravel, etc. Usually carried on the head by coolies.

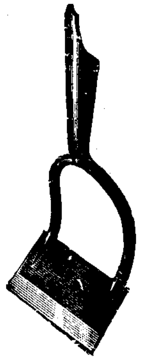
Basket, transport (large). Removing leaves, grass, light rubbish, etc.
Bill-hook. Wak-pihiya, *S*. Lopping branches, etc.
Branch-pruner. For cutting stout branches.
Crowbar. See Alavango. **Disc-harrow.** See Plough.
Dibber or **Dibbler.** Holing for small seedlings, cuttings, etc.
Edge-cutter. Cutting turf-edges, as of paths, beds, etc.
Edging-shears with long handles. Trimming grass-edges.
Flower-cutting scissors. Convenient for cutting flowers of thorny plants.
Fork, digging. Mulluwa, *S*. Digging, turning manure, etc.
Fork, weeding. Weeding, stirring up surface of beds and borders.
Fruit-picker. Kekka, *S*. Long-handled; picking fruit or flowers, etc., from branches not easily accessible.
Garden "engine." A water-barrow with force-pump and hose. Useful for syringing, spraying, or watering plants over-head.
Gloves, pruning. Enabling spiny plants to be pruned or handled with ease.
Grindstone. Indispensable for sharpening tools.
Grubber or **Cultivator.** Various forms and sizes. Useful for cultivating or stirring the soil between rows or drills, etc.
Hand-cart. Ath-karatthe, *S*. Removing plants, soil, manure, etc.
Hoe, draw. Weeding, earthing up crops, etc. Preferred by coolies for weeding paths, borders, etc.
Hoe, roller. Suitable for weeding soft soil or loose gravelly paths.
Hose, garden. Watering lawns, borders, etc.
Knife, budding. Budding plants, cutting flowers, etc.
Knife, grass. Sickle or "hook"; De-kettha, *S*. Cutting grass, grain-crops, etc., instead of with scythes.
Knife, pruning. Pruning, grafting, etc.
Lawn-mower. Various sorts and makes, being driven by chain gear, cog-wheel gear, or motor. Perhaps the most suitable for a small garden is a 12 in. cog-wheel gear mower. For larger gardens or golf links a motor mower is useful.
Lawn sprinkler. Watering lawns, flower-beds, etc., being fixed to a hose.
Lawn-weeder or **Daisy-grubber.** Extracting deep-rooted weeds, as "Etadi."
Mamoty. Udella, *S*; Mamoty, *T*; Kodali (India). Digging, weeding, etc. The implement most generally used by coolies for all purposes, with the blade at right angles to the shaft.
Mamoty-fork. Pohara-mulluwa, *S*. Digging, grubbing, stacking manure, etc.
Pick (both ends pointed); **Pickaxe** (one end pointed, the other broad for cutting roots). Pickasia, *S*. Loosening hard soil in trenching, picking roads, etc.
Plough. Nagula, *S*. Ploughing paddy fields or other soft ground.
Plough, disc or **harrow.** Bullock-draught; cultivating open sandy soil.
Posthole-digger. Making holes for fence posts or for plants.
Quintane. A narrow form of mamoty with a sharp edge for cutting.
Raffia. Tying material, much used in gardens of temperate countries.
Rain-gauge. Measuring rainfall.
Rake, iron. Smoothing and levelling the surface of seed-beds, paths, etc.
Rake, hay (wooden or wire). Raking grass or leaves off lawns, etc.
Reel, garden. An iron reel with stout cord; useful in making or cutting straight or curved lines.
Roller, garden. Rolling and levelling paths, lawns, greens, etc.
Root-puller. 2-pronged fork for extracting weeds with long tap-roots from lawns.
Saw, pruning. A saw with a short, narrow blade.
Scrape, weeding. Used by coolies on estates or garden, etc.
Scythe. Cutting long grass, etc. A small pattern suitable for use by coolies.
Secateurs or **pruning scissors.** A powerful instrument for use in one hand in pruning.
Shears, hedge-cutting. Clipping hedges, etc.
Shears, spring or **sheep.** Popular with coolies for trimming grass verges.
Shovel. Iskoppay-henda, *S*. Removing gravel, earth-work, etc.
Sieve. Peneray, *S*. Sifting soil, etc., for potting composts; different sizes, from $\frac{1}{4}$ to 1 in. mesh.
Soil stirrer or **aerator.** A central fork with revolving arms set at different angles.
Spade. Iskoppay, *S*. Mixing or turning soil, cutting turf, earth, etc.
Spirit-level. Taking levels of plots, roads, buildings, etc.
Sprayer, Knapsack. See "Antipest."



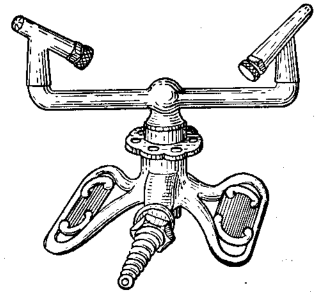
FRUIT PICKER AND BRANCH PRUNER.



SECATEURS OR PRUNING SHEARS.

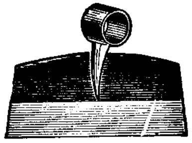


DUTCH HOE.



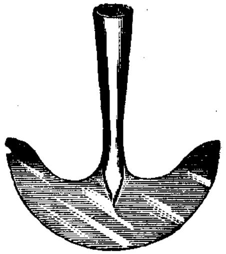
"RAIN KING" LAWN SPRINKLER.

STUMP EXTRACTOR.



DRAW HOE.

FORK-HOE.



EDGE CUTTER.

Stump extractor or Monkey Jack. Excellent for removing tree-stumps.
Sulphurator, or powder-sprayer. Distributing sulphur or tobacco powder on plants affected with mildew or small insects.
Syringe, garden. Vasthi-kooduwa, *S.* Spraying water on plants, both for cleansing them and creating a moist atmosphere; also spraying with insecticides.
Tree-pruner. Pruning tall shrubs or trees.
Trowel. Kuda-iskoppay, *S.* Planting out small plants.
Watering-can. Watura-kendiya, *S.* Watering plants in pots, beds, etc. 2-gallon capacity is a convenient size.
Weeding-fork, hand. Stirring surface of beds or borders.
Weeding-fork and hoe combined. Weeding and surface-stirring.

CHAPTER IX

LAYING OUT A GARDEN

SEE ALSO PP. 54–56

THE laying out of a garden is often a vexing problem, yet it is capable of affording the most absorbing interest and mental recreation. Though much of the success of a garden depends upon its original design and apportionment, the work of laying out may be said to be progressive, and can hardly ever be considered to have attained a finished state. It is in this fact that much of the charm of gardening lies—the ever-varying opportunities of effecting changes and carrying out new schemes and ideas. In giving the following suggestions, it must be remembered that no hard and fast rules can be laid down, as so much depends upon individual taste, local circumstances, climate, lay of land, water-supply, labour available, etc.

Position. A favourable position may be said to be the most valuable asset that a garden can possess. Much can be done, however, to overcome physical disadvantages and obstacles, so that the most unpromising situation may sometimes be converted into a delightful garden. The first consideration usually is, how to transform and beautify present conditions with the least possible expenditure of time and labour. It should be remembered that it is often easier to transform than remove an ugly object, and that immovable obstacles may sometimes be turned into ornaments.

Improving Existing Conditions. In commencing a garden, the mistake is sometimes made of cutting out all the existing vegetation, forgetting that this, although it may be "jungle," may not only have certain ornamental features, but may also be capable of furnishing useful shade or shelter until at least other trees will have had time to grow up. Moreover, where virgin vegetation exists, a good effect may be quickly obtained by selecting portions and isolating them into clumps, or separating the best trees to form solitary specimens, levelling and turfing the ground between. Details can be attended to later, and a choice variety of plants may gradually take the place of the less desirable ones.

Aspect and position of bungalow. Much of the success of a garden depends on aspect (see *Climate*), not only with regard to the points of the compass, but also with reference to lay and contour of land. Natural shelter from prevailing winds, commanding views, a constant and liberal water supply, and gently undulating ground are all important factors. The bungalow should be regarded as the centre of the scheme, and special features or views should be commanded from the front verandah and windows. (See *Plan of Garden.*)

Designing or Planning. It has been said that a garden is best planned on the ground; nevertheless a sketch or diagram on paper, however deficient, will help to visualise the mind's plan. The ground may thus be easier apportioned, and space allotted to the various purposes as may be required. This will not only save time and labour, but probably also confusion and disappointment later. At the outset it is essential to distinguish between the front and back of the garden. The main features should first be sketched out, starting with the drive or leading walk,

followed by smaller paths where necessary. These, as well as the borders, etc., may then be marked on the ground by means of string and wooden pegs. Lawns should predominate, especially at first, for it is easy to convert these afterwards and introduce beds and borders as may be desired. (See *Lawns.*)

Water-supply is of course an essential provision for every garden, and on this the scheme of laying out must to a large extent depend. In the low-country or plains, the garden is not unusually supplied from a well; whilst up-country a diverted stream can generally be made to meet requirements. It is important that the source of supply should be placed where the water will have the readiest access or be easiest conveyed to all parts of the garden. If a well, it should be concealed from view with tall shrubs or small trees.

Preparation of the Ground. The ground must be thoroughly trenched and drained, the soil being turned over to a depth of 16 in. or more, and all large stones, roots or other obstacles removed. A certain amount of levelling will be necessary, it being important to obtain a uniform, even surface with a fine tilth, while the condition of the soil may require to be improved by the addition of suitable manurial material. If the land be steep, it should be formed into **terraces**, which often lend themselves to a very pleasing effect.

Shade and Wind-breaks. In the low-country the first consideration should be to provide a certain amount of shade or screen where such does not already exist, while at the higher elevations it is equally important to furnish shelter from strong winds by means of wind-breaks in the form of trees, supplemented, if necessary, by hedges and shrubberies.

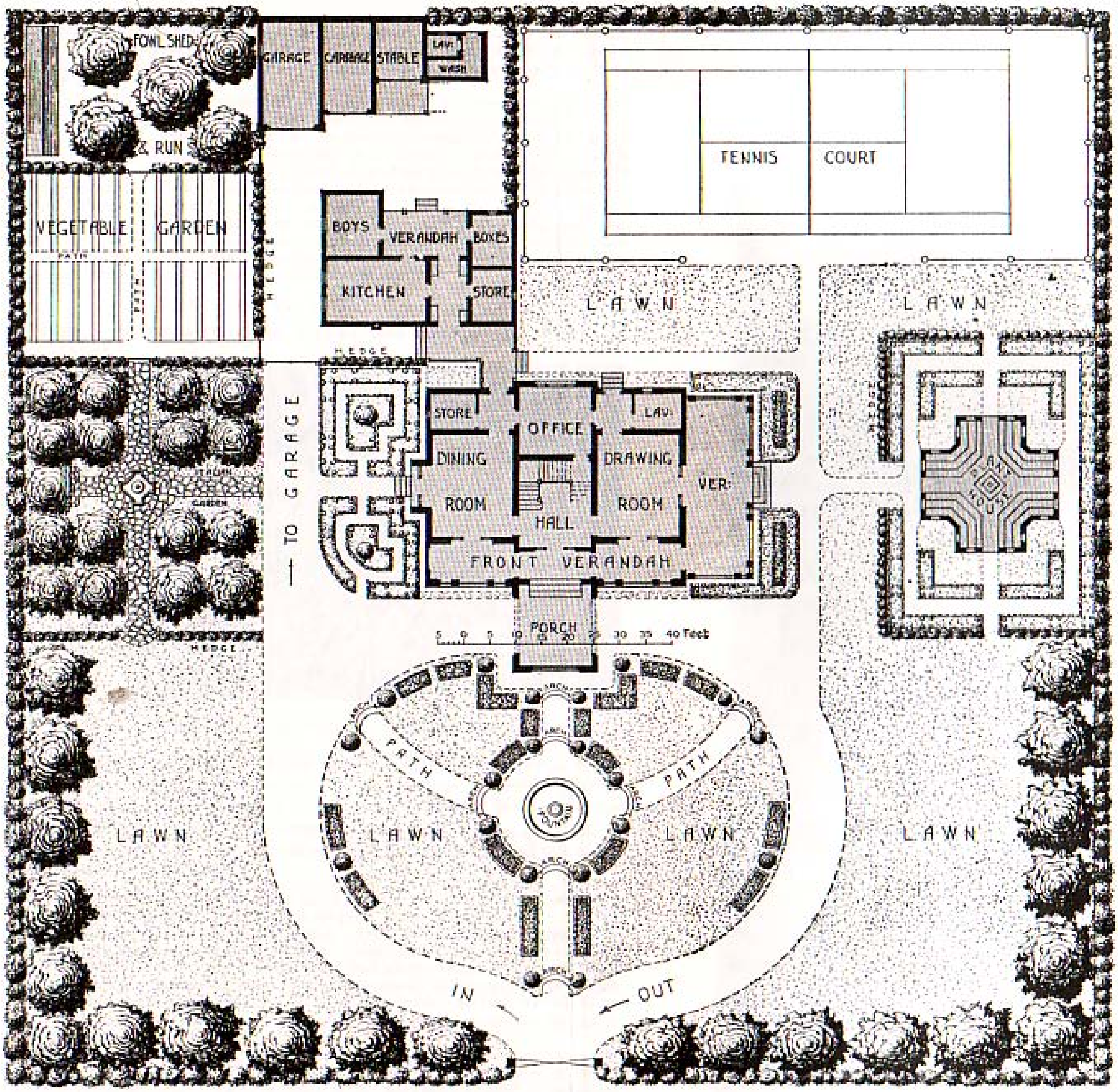
Planting-out. All preparations should be made before procuring or removing the plants to be planted. Not only should the ground be dug deeply and if necessary manured, but holes should be made for the larger kinds, and stakes as well as means of temporary shade be ready at hand. Planting should, of course, be done in wet weather. (See *Planting.*)

Walks and Paths are, it has been said, a necessary evil in a garden; yet in the tropics, as ladies especially will admit, they are particularly indispensable, owing partly to the presence of land-leeches, ants, etc., which infest the grass at different seasons. Though essentially for convenience, paths may, however, be so planned as to add to the artistic effect and enjoyment of a garden, as when they wind through a fernery or rockery, or lead round a group of shrubs or palms. Winding paths should wind for a purpose, and a group of shrubs may be introduced to divert a path from a straight line. On the other hand, a straight path may enhance the beauty of a border or a vista. Paths should not be too numerous or too narrow, a width of about 3 to 4 ft. being suitable for a small garden. This allows for two persons to walk comfortably abreast. In more extensive gardens or public parks, the main walks may be 12 to 15 ft. or more in width. The Long Walk at Windsor Castle in England is about 50 ft. wide and 2 miles long. In large or public gardens in the tropics, where walking is often an exertion, the principal walks or roads should be sufficiently wide to admit of their use by carriages and motor cars, as in Peradeniya Gardens, Ceylon.

In making paths, a good foundation and drainage are essential. Having removed the soil to a depth of at least 12 in., place a layer of drainage material (stones, broken bricks, etc.) in the bottom; cover this with coarse binding gravel, followed by a layer of finer gravel and finishing with a slight camber, watering and rolling the surface well down. Cut a small parallel side-drain on either side of the path, below the level of the latter, leaving a strip of turf not less than 12 in. wide between this side-drain and path; small slanting channels should be made at intervals to lead into the side-drains, so as to facilitate the escape of rain water from the path during heavy rainfalls.

Paths should not have too steep a gradient, or they will be liable to get washed away by heavy rains. This can be obviated on steep slopes by introducing graceful curves or flights of easy steps, which will also make walking pleasanter. To maintain the paths in a clean and even condition, free from weeds and hollows, is a matter of first importance. The grass verges should always be cut evenly and straight, not notched or crooked at the edges, and this is best done by the use of edging-shears. Weedy paths, with neglected margins, give an unfavourable impression of their surroundings.

Cobble-stone or Crazy Paths. These have a certain pleasing old-world effect. They are also useful on steep slopes or in situations exposed to heavy drip, but cobble stones are not always appreciated for walking on. Crazy paths are made



PROPOSED PLAN OF A GARDEN.

Showing also ground plan of a modern two-storeyed bungalow.

[*Between pp. 62 and 63.*

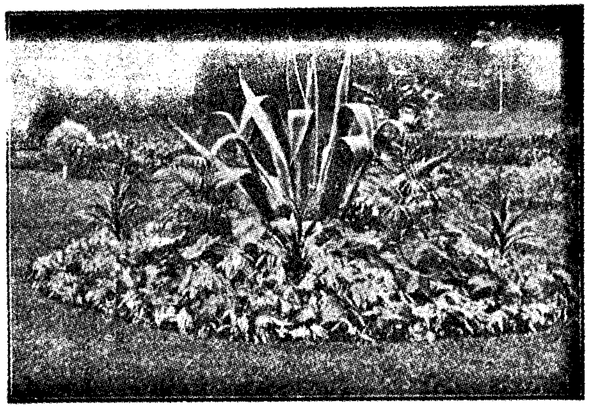
of flat rectangular stones of different shapes and sizes laid on a prepared foundation of gravel, with small interstices left between for the growth of dwarf plants. These are popular in cool countries, and have the advantage of being easy to keep clean and free of weeds.

Turf paths when well kept are delightful to walk on in dry weather, but they are not suited to wet districts or to situations which are liable to be sodden.

Drains and Culverts. Provision for the escape of excessive rain water must be made in the tropics. Paths, roads, terraces, etc., should therefore have ample surface drainage; good culverts, with a cemented and sloping foundation, should be made wherever water is liable to accumulate after heavy showers. It is advisable to build at the higher end of each culvert a **silt-pit**; this will not only collect the washed-away gravel, which may again be used on the paths or roads, but also prevents leaves and rubbish from entering and choking the culvert. Small surface channels, as inconspicuous as possible, should be made wherever surface-wash is liable to occur, whether in the flower- or vegetable-garden.

THE FLOWER GARDEN

Background. A background of mixed tall foliage and flowering shrubs, the taller kinds at the back and gradually smaller ones towards the front, does much to enhance the beauty of a garden. In this way all the plants will be seen at once from the front. In the case of borders which are to be seen from both sides, the taller plants should, of course, be planted towards the centre.



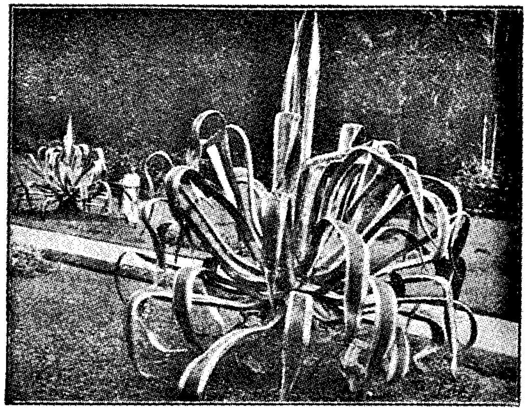
EFFECTIVE GROUPING OF COLOURED FOLIAGE.

Bedding, Grouping, etc. As a general rule, either flowering or foliage plants look most effective when massed in large beds or groups, or in rows, circles, irregular patches, etc., as component parts of these. Frequently, however, the effect of **mixed planting**, according to some definite colour arrangement, is very pleasing, the beauty of many species being thus enhanced both by contrast and harmony with others.

The beds should be of simple designs, such as the square, oval, circle, and rectangle. A large circular bed, formed of a sloping mass of harmonious colours from centre to margin, is always a pleasing sight. Beds of elaborate designs, with many points and acute angles, should be avoided; they involve much more labour than simpler forms, and it is not always possible to find plants which can be adapted to very small corners. An exception may perhaps be made in favour of the **carpet bed**, which, when space permits and suitable plants are available, can be very effective. It should be remembered that the beauty of a garden does not consist in fantastic designs and serpentine wriggles.

In order that the beds and borders may be maintained in a proper condition and seen to advantage, they should not be placed too close together; sufficient walking and working space must therefore be left between them, and they should, if possible, be surrounded by lawn, which if well kept forms the most beautiful setting. Plants of mediocre quality will present an effective appearance when set in well-kept green

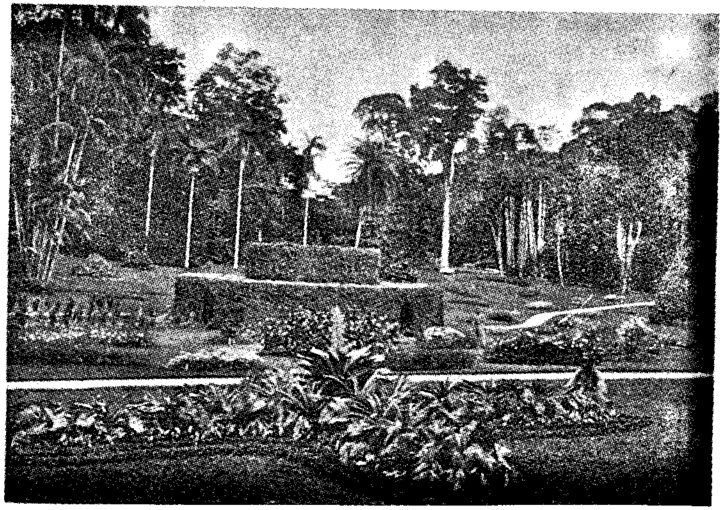
sward. In large gardens the grouping of Palms, Heliconias, Cannas, shrubs, variegated grass, Caladiums, etc., in what is called the "natural style," has much to recommend it. In this the object is to group the plants harmoniously, according to their habit, colour of flowers or leaves, into isolated clusters. Irregular groups of ornamental shrubs may be planted with good effect at the bends and curves of walks or drives. The effect of either beds or borders can sometimes be enhanced by raising the soil well in the centre.



VARIEGATED AGAVES USED FOR ORNAMENTAL EFFECT.

Ribbon Borders, in which different small plants of contrasting colours but similar size are planted in lines, may have a pleasing effect. This is all the more striking when carried out on a fairly long and broad border, but violent contrasts of colour should be avoided.

Foliage Plants for Colour Effect. In a garden where a continuous rather than a periodical display is aimed at, free use must be made of coloured foliage plants. These may, in fact, be arranged so as to present by their striking colours an effect equal to or surpassing that of flowering plants (see p. 14). It is to such foliage plants that much of the fine effects in the flower-garden at Peradeniya, Ceylon, is due. Flowering plants should, however, find a place when suitable kinds are obtainable;



VIEW IN FLORICULTURAL SECTION, ROYAL BOTANIC GARDENS, CEYLON.

these make the most striking display when each kind is grown in masses. Unfortunately, in the tropics the flowering period of many of the most showy plants is of a brief duration. At the higher elevations, however, a beautiful display of flowering annuals may be obtained throughout the dry season, while various **bulbous plants** (which see) may supply a succession of flowers during the intervening period.

Banks or Double-cuttings, which often occur in a garden, may be so treated as to render them interesting and ornamental. Where sufficiently shaded, they may be occupied by a pleasing variety of ferns and small foliage and flowering plants, which should be planted in pockets filled with rich humus soil. If the ground be much exposed, it may be either covered with smooth turf, or planted with showy forms of sun-loving creepers, bulbous plants, etc.

Ornamental Water. Water in almost any form adds greatly to the attractiveness of a garden, park, or pleasure ground, and should be introduced, if possible, when not already present. An expanse of water is most appropriate in a hollow, in imitation of nature, and should not be too close to the dwelling-house, especially in the tropics, where it may serve as a breeding-ground for mosquitoes, except perhaps at the higher elevations. **Islands** with an irregular outline, planted with suitable shrubs and perennials, have a pleasing effect so long as they do not look too artificial. The water margins should not be too thickly planted and, in order to provide a mirror for the reflection of the banks, at least two-thirds of the water surface should be kept clear of plants. (See *Water Plants.*)

Cascades or Waterfalls. Rippling streams or small cascades in a garden have a charm all their own, and should be introduced whenever possible. Even when the fall of water is only a few inches, a pleasant rill may be produced by the skilful arrangement of rough stones laid irregularly so as to form small cascades, imitating as far as possible a natural rustic arrangement.

Rockeries. A taste for rockeries in gardens has much developed in recent years, and in temperate countries most charming schemes may be seen. Success depends largely on locality, water supply, and suitable rocks or stones. The latter should be rough and bold, or somewhat flat and angular, and laid in irregular outline, but following one general direction, so as to resemble natural strata. Fissures and pockets should be left between, with patches of good soil placed here and there. Winding paths paved with flat stones in an irregular fashion, with rustic steps introduced where possible, add much to the general effect.

Informal pools of water and small cascades rippling over rocks produce a pleasing effect, while the rill of a concealed streamlet has a special charm. In the tropics it is not easy to get quite the desired conditions, except perhaps at the higher elevations, where the climate more resembles that of a temperate country. At low elevations, shade by means of evergreen trees is essential, though this has the objection of encouraging mosquitoes, especially where there is water. At higher elevations such shade is not necessary or desirable, but shelter from prevailing winds is indispensable.

Much of the success of a rockery depends of course on the plants chosen, which should, generally speaking, be of a dwarf and evergreen nature, such as small succulent or bulbous plants. Unfortunately the number of these suited to tropical conditions is limited. For up-country the following are examples: Agapanthus, Bambusa Fortunei, Begonia (fibrous-rooted, etc.), Bellis (Daisy), Cineraria maritima, Cotyledon (Echeveria), Dicentra eximia, Santolina (Cotton-lavender), Indigofera decora, Salvia patens, Vinca minor, Violets, Vittadinia, Zephyranthes, Selaginella, and small ferns. A selection for the low-country should include such as dwarf Caladiums, Alocasia, Amaryllis, Achimenes, Anthurium, Dracaena sanderiana, variegated Pine-apple, Cryptanthus, Costus elegans, Moraea, Anthericum, Verbena, Eucharis, Belamcanda, Coleus pumila, Zephyranthes, Streptocarpus, Ophiopogon, Phalaris, Kalanchoe, Karatas, Peperomia, Impatiens repens, Ruellia colorata, Saintpaulia, Selaginella, ferns, etc.

Fernery. A well-formed fernery affords a pleasing variety in a garden, and when once established needs but little attention. The essential requirements are shade, a constantly moist atmosphere, and shelter from strong winds. For laying out, similar remarks as for rockeries may be applied, except as regards shade and moisture, which for the latter are not essential. (See Chap. X, also *Ferns.*)

LAWNS

It has been well said that a lawn to a garden is as a background to a picture. An expanse of smooth, green sward has a special restful effect and a distinctive charm; it enhances the beauty of surrounding objects, whether they be trees, shrubs, or flower-beds, and forms a most pleasing setting to a bungalow or dwelling-house.

Levelling, draining, etc. In making a lawn, it is essential that the ground be first properly prepared, the surface being thoroughly dug and uniformly levelled, coarse stones, roots and other obstacles being removed and the surface raked smooth.

If the ground is of a heavy clayey nature it should be properly drained. Provision may also have to be made for the escape of excessive rain-water, unless the ground is fairly flat and the soil of a loose sandy nature. Where the soil is very poor or gravelly, the turf is liable to become patchy in dry weather; therefore some heavy soil or clay should be forked in or laid on the surface. During periods of severe drought, nothing but daily and liberal watering, preferably after sunset, will prevent the grass becoming parched and brown. Pegs should be driven into the ground at given points and at intervals between these, so that the desired level or gradient may be obtained by means of a spirit-level and a long piece of wood with a straight edge.

LAWN-MAKING BY DIBBLING GRASS ROOTS.

Turfing. Laying turf by hand is the quickest and, at least for low elevations, the most satisfactory method of forming a lawn in the tropics, seed-sowing being generally precarious. The turves should be obtained from close-grazed pasture land, and cut as nearly as possible of uniform thickness. This is best done with a spade, though a mamoty will answer the purpose, and this is the easiest tool for coolies to handle. The turves should be used fresh, placed close together, the soil being worked in between to fill up all interstices, finally sprinkling some fine soil on the surface and brushing it in with a stiff broom. The turves being beaten down into position with a flat, heavy piece of wood, the whole surface should afterwards be thoroughly rolled and watered.

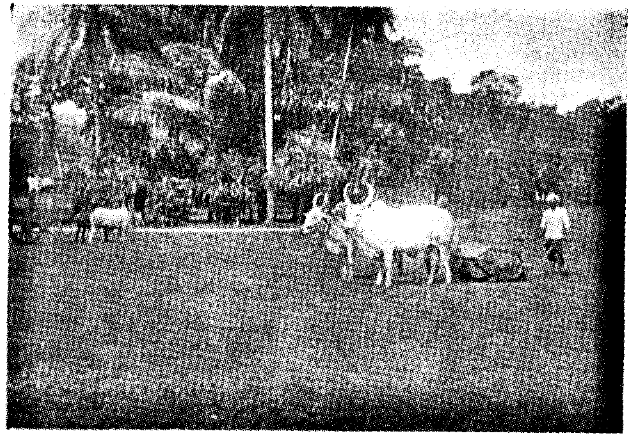
Turf-grafting. In the case of a large area, or when turf or labour is scarce, economy of both may be effected by laying small portions of turf a foot or less apart, sunk level with the surface and beaten down firmly. These will soon spread and cover the intervening spaces.

Dibbling or stippling small selected grass roots, obtained from close-grazed local pasture, is a rapid and economical method of forming a lawn, the soil being first brought to a fine tilth and uniform level. If the roots are dibbled in a few inches apart in wet weather, and the surface afterwards rolled and watered, a green sward is soon formed.

Mud-plaster with chopped grass stems is a method commonly employed in India for making lawns. The grass roots and stems are chopped up, mixed with mud of about the consistency of mortar, the mixture being then spread evenly over the surface and levelled with a board. It is then kept moist by sprinkling with a syringe, or with a watering can and a fine rose. This method is especially suited to a dry climate.

Lawns from Seed. Although lawn-making from seed is not usually satisfactory

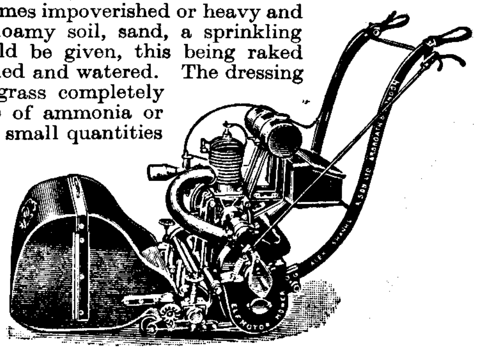
on the plains, at the higher elevations it is sometimes fairly successful. Here certain "English" lawn-grasses may thrive for a time, but unless carefully watched for weeds, etc., they are soon superseded by coarse indigenous species. For forming a close sward, 1 oz. of seed to the square yard would be a liberal allowance. At low elevations, however, a uniform green sward can seldom be obtained from seed, owing to the rapid growth of weeds, prevalence of bird and ground pests, and the liability of the seed to being washed away by heavy rain, or injured by drought. Whichever method is adopted, the margins of walks and flower-beds should always be laid with a continuous strip of turf, about a foot in width, to form a verge.



BULLOCK-DRAWN LAWN MOWER AT WORK IN PERADENIYA GARDENS, CEYLON.

Upkeep of Lawns. The success of a lawn depends upon its proper upkeep; it should as far as practicable be kept free of weeds, mowed at brief intervals with a mowing machine, and never allowed to produce seed-stalks or wear a neglected appearance. A heavy roller should be used frequently, but not when the ground is either very wet or dry. A mower should not be employed until a firm green sward has been formed, the grass at first being cut with a scythe or sickle and the surface rolled.

Top-dressings. When a lawn becomes impoverished or heavy and sodden, a top-dressing consisting of loamy soil, sand, a sprinkling of lime and well-rotted manure should be given, this being raked well in, and the surface afterwards rolled and watered. The dressing should not be sufficient to hide the grass completely from view. As a stimulant, sulphate of ammonia or nitrate of soda may be applied in very small quantities at intervals, say at the rate of ¼ oz. per square yard. In order to ensure even distribution, this should be mixed with finely sifted dry sand or soil, or dissolved in water at the rate of 1 oz. per gallon and applied through a rose.

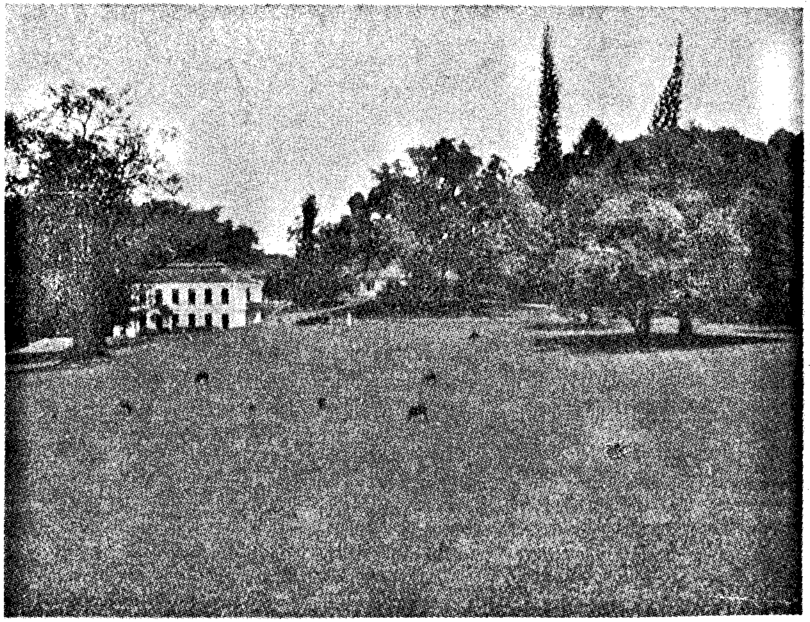


SHANKS'S MOTOR MOWER.

Lawn Sand is often used as a stimulant for lawns in cool countries, its effect being to discourage the growth of large-leaved plants or weeds and encourage the growth of fine-leaved grasses. It must, however, be used in very small portions at a time (not more than 1½ oz. per square yard), as otherwise it will temporarily destroy the grass. It may be made up of: sulphate of ammonia (3 parts), sulphate of iron (crushed, 1 part), and finely sifted dry sand, 20 parts.

Enemies of Lawns. Among the most troublesome of these are termites and ants, more especially the common white-ant, whose nests should be looked for and destroyed at the earliest signs, either by digging for the queen-ant, or pouring poison, or pumping poisonous fumes, down their crevices. Cockchafer larvae and beetle grubs, which are often destructive to the roots of grass, may be kept in check by an occasional sprinkling of "vaporite" on the ground. (See *Pests.*)

Certain weeds are particularly partial to lawns, one of the worst being the "Elephant's foot" (*Elephantopus scaber*). These and other large-leaved weeds should be dug up with a spud or daisy fork, or they may be killed by dropping into their centre a very small pinch of sulphate of ammonia. The latter in a solution, say 2 oz. to a gallon of water, is also used as a **remedy for clover** in lawns. (See *Weeds*.) Worm-casts in lawns are objectionable, though their presence is considered a good sign, as the worms' food consists of decayed vegetable matter which, after being digested, is ejected in the form well known as worm-casts, while the worms by their burrows help to aerate and drain the soil. Perhaps the best destroyer is corrosive sublimate, a deadly poison. Dissolve 1 oz. in hot water and add 20 gall. cold water. Apply through a rose on a moist day. Sweep up and remove the worms as they come to the surface. Watering the ground with lime water or a weak solution of ammonia will cause the worms to come to the surface, when they may be collected and destroyed.



Portion of Great Lawn, Peradeniya Gardens, Ceylon.

Moss on Lawns is caused by faulty drainage or excessive shade and moisture; therefore improve the drainage, rake out the moss with an iron-toothed rake, and top-dress with a good compost as recommended above, adding lime in the proportion of 3 oz. per square yard. A solution of sulphate of iron, 1 oz. to a gallon of water, applied through a rose is also effective.

Puff-balls (a fungus) are not often troublesome on lawns in the tropics. The usual remedy consists of a few applications of dissolved sulphate of iron, say 8 oz. of the latter to 1 gallon of water. The same remarks apply to **Fairy-rings**, caused by the mycelium of a fungus, but these require more frequent applications to eradicate. (See *Fungus Diseases*.)

Suitable Grasses for Lawns. As to what constitute the best grasses for lawns, much depends on climate and soil. Often, selected kinds from close-grazed local pasture give the best result, and of these the finest-leaved species should be chosen. Among the most suitable are: *Cynodon dactylon* (Doob, Bermuda- or Devil's grass; Arugam-pillu, *T*), with fine leaves and long, slender runners; *Panicum longiflorum* (Blue-grass; Sellaipillai, *T*), forms fine bluish turf when young (see *Pastures*); *Paspalum sanguinale* (Guru-wal, *S*); *Chrysopogon aciculatus* (Love-grass; Tuttiri, *S*), which resists drought well, forms excellent turf in the moist low-country, in spite of the objection to it when allowed to seed, owing to the sharp hooked awns which adhere to and penetrate one's clothes. To these may be added the very small-leaved clover-like perennial, *Desmodium triflorum* (Hin-undupiyala, *S*), which has small purple flowers and is specially suited to dry, rocky soils. The ordinary self-formed turf on the lawns in Peradeniya Gardens consists chiefly of the above in addition to the following—*Ischaemum ciliare* (Rat-tana, *S*), *Setaria glauca* (Kawulu, *S*), *Sporobolus diander*, and *Anthistiria tremula*. Under the shade of trees, the principal turf-grasses are *Paspalum obtusifolium*, *Paspalum conjugatum*, *Panicum trigonum*, *Oplismenus compositus*, and *Apluda aristata*. The grass known locally as the "Jamaica Sour grass," and in the Philippines as "Bitter grass" (*Paspalum conjugatum*), is an introduced species from the West Indies which has become completely naturalised in Ceylon; it is specially adapted to shady situations, and when kept closely cut forms very fair turf. At the higher elevations, certain "English" grasses will thrive, at least for a time, in well-prepared ground, and grass-seed mixtures adapted for different purposes may be obtained from seed-merchants in Europe and elsewhere. *Panicum repens* (Couch-grass; Etora, *S*), which is deep-rooted and drought-resistant, forms good turf, as does also *Paspalum dilatatum* when closely mown. (See *Fodder Grasses*.)

HEDGES AND BOUNDARY FENCES

For several reasons a garden in the tropics should be enclosed by a good hedge or fence—that is, if exclusion of cattle and vermin, shelter from wind, and privacy be considered essential. Well-kept hedges can be ornamental as well as useful; they form protective boundaries, shut off private quarters, divide portions when necessary, or conceal unsightly parts. The suitability of a species for a hedge depends upon the purpose and locality for which the latter is required.

An ornamental hedge of coloured foliage may be formed of Acalypha, Croton, Panax, Pisonia, Cordyline, etc., either mixed or singly; whilst for a hedge of flowering plants, different varieties of Hibiscus, Ixora, Poinsettia, Thunbergia erecta, etc., make a striking display. A hedge should be begun with a good foundation, a trench 18 in. deep by about 18 in. wide being dug. The soil should be enriched with some well-decomposed manure or some humous material; otherwise unevenness of growth or gaps are likely to occur. When a hedge has to answer the purpose of a barrier, a good plan is to run a few strands of barbed wire along the centre; or, if the wire-fence is already in position, the hedge may be planted (or sown) by its side; or the wire-fence may be beautified or concealed by growing light ornamental climbers over it. An excellent barrier hedge may be formed by means of some spiny or prickly plant, as Yucca, Agave, Euphorbia, Cacti, etc. See *Cacti*.

Hedges are usually formed from cuttings planted where intended to grow, but certain hedges, especially those of a permanent nature, are best formed from seed sown *in situ*, as Madras-thorn, Malpighia, Logwood, Phyllanthus, Triphasia. The seed should be sown thinly, about 5 in. apart in double or treble rows. Thus 1 lb. of seed of the Madras-thorn should be sufficient to sow 50 running yards.

Clipping Hedges. In clipping or trimming a hedge, it should always be remembered to keep it narrower at the top than at the bottom, otherwise it becomes bare and leafless towards the ground. Hedges of large or broad-leaved plants should not be clipped with shears, but trimmed with a knife or secateurs.

SELECTED HEDGE PLANTS

(A). For Low Elevations, Ornamental or Screen

[Letters in brackets indicate usual means of propagation, thus: (C.) = cuttings; (S.) = seeds; (Div.) = division; (Su.) = suckers; (Tu.) = tubers. Figures = usual height in feet. For fuller information see Chapters XII, XV, XVII.]

Acalypha. Different varieties. Quick-growing, 6–10; large coloured leaves. **(C.)**

Aralia filicifolia (Panax). Erect shrub, 6–8; handsome fern-like foliage, yellow when young. **A. Guilfoylei.** Quick-growing, erect; leaves variegated. (C.)

Bambusa nana. Dwarf or Chinese Bamboo, 6–8 or more. (Div.) (See *Bamboos.*)
Barleria cristata. Dense shrub, free-flowering, 4–6; flowers white, mauve, or rose-pink. Quick-grower. Commonly grown as a hedge in Colombo. (C.)
***Brunfelsia uniflora.** Erect flowering shrub, sweet-scented, 4–6. (C. or S.)
Casuarina equisetifolia. Quick-growing, can be kept low for several years. Makes a good dense hedge, especially near the sea. (S.) See *Trees for Dry Regions*, etc.
Croton (Codiaeum). Different var's, which see. Handsome, coloured leaves. (C.)
***Duranta Plumieri.** Duranta. Large shrub or small tree, 6–8 or more. (C. or S.)
Ehretia buxifolia. Ceylon Boxwood. Slow-growing, dense foliage, 3–4. (C. or S.)
***Hibiscus rosa-sinensis.** Shoe-flower. Numerous varieties. Quick-growing, free flowering if not clipped. 6–10. (C.) (See *Flowering Shrubs.*)
Justicia gendarussa. Small bushy shrub, 3–4. (C.) Logwood. See selection (B.).
Malpighia glabra. Barbadoes Cherry. Close-growing prickly shrub, 4–6; much used for hedges in W. Indies, etc. The cherry-like fruits are edible. (S.)
Murraya exotica. (Limonia.) 6–8. (S.)
Panax fruticosum. (Aralia.) Erect shrub, 6–8; handsome, deeply-cut foliage. (C.)
***Phyllanthus myrtifolius.** Ceylon Myrtle. Slow-grower, 5–6 ft., or dwarf; small leaves, dense foliage. (S. or C.)
Pithecolobium dulce. Madras Thorn. Quick-grower, thorny, 5–8 or more. (S.)
***Punica granatum.** Pomegranate. (S. or C.) Quick-grower. 5–6. Showy, scarlet flowers, especially suited to a dry climate.

(B). FOR BOUNDARIES OR BARRIERS

Acacia tortuosa. Cushaw. Spiny sh., forms dense hedge; suited to dry districts. (S.)
Agave americana variegata. American Aloe. Slow-growing, 5–6. (S. or Su.).
Balsamodendron Berryi. Mul-kilivai, *T.* Dense and spiny; makes a good hedge.
Bambusa nana. Dwarf Bamboo, 6–8; ornamental and barrier. (Div.) See above.
Bougainvillea spectabilis. Shrubby climber, spiny, free-flowering, very ornamental when in flower. (C. or S.)
Bromelia Pinguin. (*Bromeliaceae.*) Trop. America. Long, narrow leaves, with sharp, hooked spines. Several other species. (Div. or S.) See *Fibres.*
Caesalpinia Sappan. Sappan-wood. Spiny, straggling shrub. Interlaced branches form strong barrier. (S.) See *Dyes.*
Citrus decumana. Pomelo. Small spiny tree, 10–15 or more. (S.)
Clerodendron aculeatum. "Wild Coffee" of W. Indies. Slow grower, 5–6, spiny.
Euphorbia Antiquorum. Daluk. Quick-grower, 6–15. Very thorny branches, milky juice poisonous. E. Tirucalli. Milk-hedge; Nawa-handi, *S.* Quick-growing, commonly used in Ceylon as boundaries for paddy fields. (C.)
Flacourtia Ramontchi. Governor Plum. Forms a close, spiny hedge; used as such in W. Indies and elsewhere.
Gymnosporia emarginata. Straggling, spiny shrub. (S.)
Haematoxylon campechianum. Logwood. Slow-growing, small, spiny tree; good barrier. (S.) See *Dyes.*
Jatropha Curcas. Physic-nut; Rata-endaru, *S.* Quick-growing, 5–6; commonly used for paddy-field boundaries. Juice poisonous. (C.)
Pereskia Bleo. Interlaced spiny stems form good barrier. Fl's. small, pink. (C.)
Pithecolobium unguis-cati. "Bread-and-Cheese" of the W. Indies, where it is commonly used for hedges. (S.)
Triphasia aurantiola. Macanchi, *S*; Myrtle-lime. Upright, spiny shrub. Slow grower. (S.)

(C). FOR UP-COUNTRY; ORNAMENTAL AND BOUNDARIES

Acalypha marginata. Copper-leaf. Quick-growing shrub. L. edged pink or white.
Berberis aristata. Berberry. Thorny shrub; barrier and ornamental. (S.)
B. Fortunei. Chinese Berberry. Slow-growing, prickly shrub, 3–4. (S.)

* Suited also to up-country.

Caesalpinia sepiaria. Quick-growing, straggling, spiny shrub. (S.)
Cestrum fasciculatum. Fairly quick-grower, 6–8, fine flowering. (S. or C.)
Cinnamomum Camphora. Camphor. Makes a close evergreen hedge. (S.)
Colletia cruciata. Slow-growing, very thorny shrub. (S.)
Cryptomeria japonica. Japanese Cedar. Small tree, evergreen. (S.)
Cupressus macrocarpa. Quick grower; makes an excellent evergreen, dense hedge for up-country. (S.) See *Orn. Fol. Trees for Up-country.*
Furcraea gigantea. Mauritius Hemp. See *Fibres.*
Ligustrum ovalifolium. Privet. (*Oleaceae.*) Japan. Close-growing shrub with small, oval leaves. (C.)
Lonicera nitida. Evergreen shrub, 5–6, dense foliage, small lvs. (C.) Recently introduced from China.
Reinwardtia tetragyna, and R. trigyna. Erect shrubs, 4–5, yellow flowers. (C.)
Spiraea peruviana. Peruvian Spiraea. Slender, quick-growing shrub. (C.)
Tecoma capensis. Slow-grower; flowers bright orange-red. (S. or C.)
Ulex europea. Gorse; Furze; Whin. Slow grower, good barrier, ornamental, 5–6. (S.) Introduced and now naturalised about Nuwara Eliya, Ceylon.

(D). HEDGES AND BARRIERS FOR DRY REGION

Acacia modesta. Phula. Slow-growing small tree, much used for hedges in India.
Agave americana. American Aloe. Lvs. pointed with long sharp spines. (Su.)
Balsamodendron Berryi. Mul-kilivai, *T.* Dense, spiny, good barrier. (S.)
Capparis zeylanica. Dense, thorny, fine-flowering shrub. (C.)
Carissa spinarum. Hin-karamba, *S.* Chirukila or Kilatti, *T.* Dense, thorny shrub. (S.) C. grandiflora. Much used for hedges in Natal, etc.
Dichrostachys cinerea. Andara, *S*; Vidattal, *T.* Slow-grower, upright, thorny, shrub. (S.)
Dodonea viscosa. Small evergreen tree or shrub, small lvs. (See p. 203.)
Euphorbia Antiquorum; and **E. Tirucalli.** Milk-hedge. (See above.)
Furcraea gigantea. Mauritius Hemp. Large, fleshy, prickly lvs. (See *Fibres.*)
Jatropha Curcas. Physic-nut. Quick-growing shrub. (See above.)
Lantana. Different species or varieties, commonly used for hedges in India, etc.
Lawsonia alba. Mignonette Tree. Henna. (See p. 204, also *Dyes.*)
Opuntia Dillenii. Prickly Pear; and other species. (See *Trop. Fruits.*)
Pandanus zeylanicus. Okeyiya, *S.* Slender screwpine, used as boundaries for paddy fields in Ceylon. (S. or Su.) P. utilis. Commonly planted as boundaries in Mauritius, Philippines, etc. (See *Fibres.*)
Parkinsonia aculeata. Jerusalem Thorn. Thorny shrub, good barrier. (S.)
Pithecolobium dulce. Madras Thorn. (S.) (See above.)
Tecoma capensis. Ornamental; fl's. bright orange-yellow. (C. or S.).
Zizyphus Spina-Christi. Nebbuk (Arabic); Kinaar (Persian). (See p. 204.)

EDGINGS FOR PATHS, BORDERS, ETC.

[*Also suited to up-country]

(A). FOR LOW ELEVATIONS

***Alternanthera.** Several varieties, 6 in. or more. Foliage bronze or greenish yellow, quick-growing. Suitable also for ribbon-border effect. (C.)
***Amaryllis (Hippeastrum).** Numerous varieties. Large, showy fl's., 1–1½. (Bulbs.)
***Anthericum liliastrum variegatum.** ½–1. Long, narrow, variegated lvs. (Div.)
Caladium Humboldtii = C. argyrites. ½–1. Small lvs., prettily variegated. **C.** bicolor. 1 ft. Lvs. with pink centre and green margin. (See *Bulbs.*)
***Caralluma campanulata.** Dwarf, leafless plant, with square stems. (C.)
Malpighia coccigera. Small shrub, adapted for dwarf edgings, like Boxwood. (C.)
***Ophiopogon intermedius.** Grass-like plant; suited to shady places; 1. (Div.)
***Phalaris arundinacea.** Ribbon-grass. Variegated lvs., ½–1. See *Grasses.*
***Phyllanthus myrtifolius.** "Ceylon Myrtle." Dense, evergreen shrub, with fine foliage, adapted for low hedge or edging. (S.)
Pilea muscosa. Dwarf moss-like plant. (See *Index.*)

Stapelia grandiflora. Small, succulent, Cactus-like plant. (C.)
Telanthera sp. (*Amarantaceae.*) Soft, velvety, small, purplish lvs. (C.)
Zephyranthes carinata. Rose Amaryllis. ½–1. Fl's. large, bright rose.
Z. tubispatha. ½–¾. Fl's. white, resembling Crocus. (Tu.)

(B). FOR UP-COUNTRY

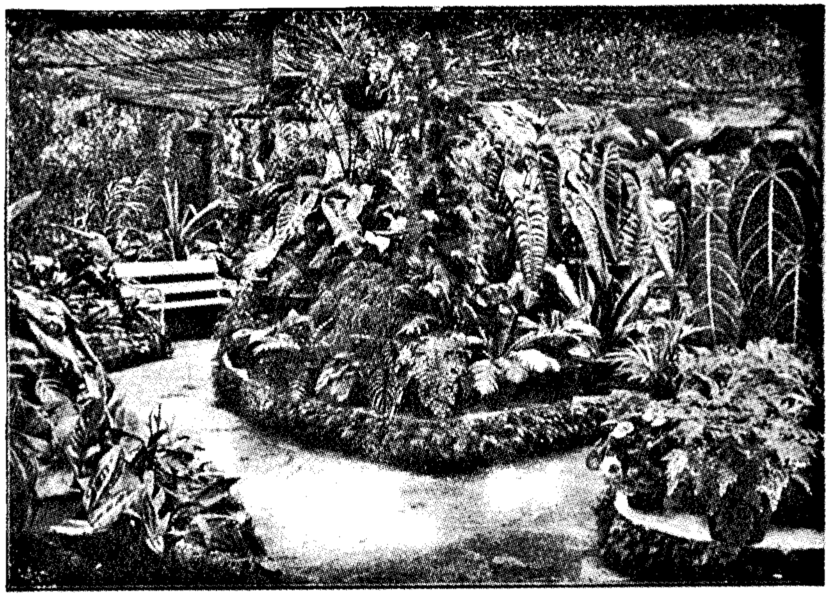
Those marked * in Selection (A) are also suitable.

Boxwood. (*Buxus sempervirens.*) Small, slow-growing shrub, with small oval lvs. adapted for dwarf edging or low hedge. (C.)
Cotyledon (Echeveria) metallica and C. glauca. Oyster Plant. ¼–½. Small, succulent, rosette-like plants. (Tu.) See *Index*.
Cyrtanthus Mackenii. African Bride. Fl's. creamy white. (Tu.)
Golden Feather (Pyrethrum aureum). Attractive yellow foliage. ½–¾. (S. or C.)
Santolina chamaecyparissus. Cotton Lavender. Whole plant glaucous grey, strongly scented. (C.)

CHAPTER X

PLANT-SHEDS, CONSERVATORIES, GREEN-HOUSES, ETC.

THE object of a plant-house in the tropics is not, except in the hills, to protect plants from the cold, but rather from the fierce sun's rays and strong winds, while also maintaining a fairly uniform and moist atmosphere. A suitably constructed plant-house of this nature, with free circulation of air and filled with a choice selection of plants, will form

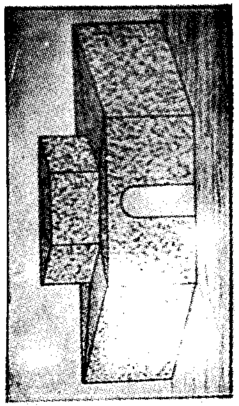


VIEW IN OCTAGON CONSERVATORY, ROYAL BOTANIC GARDENS, CEYLON.

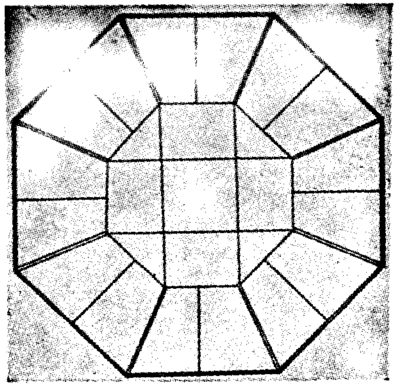
a delightful retreat during the heat of the day, in addition to affording the essential conditions for the cultivation of showy, tropical, shade-loving species. A modest structure of bamboos, covered with a few palm leaves, may temporarily serve the purpose of a plant-house, lasting for at least a year or two, but a more substantial and permanent building should have the framework composed of teak or other hard wood, or better still of iron.

The iron octagon "conservatory" in the Royal Botanic Gardens, Peradeniya, Ceylon, might be taken as a model of an economically built and eminently satisfactory type of tropical plant-house (see over). The dimensions are: outer upright supports (old rails), 14 ft. long, 3 ft. of each rail being buried in concrete; the top is

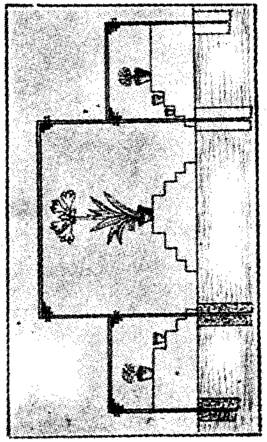
flat for a distance of 14 ft. from the circumference, and rests on horizontal rails with iron bars placed transversely at intervals of a few feet. In the centre rises an octagon "dome" with a flat top, the angles being formed by the inner upright rails, which are 21 ft. long, with 4 ft. buried in concrete. The circumference of the house is outlined by a half-brick wall, 3 ft. high, the outer edge of which is flush with the iron



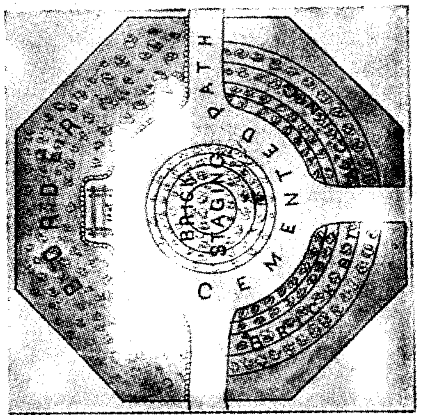
ELEVATION.



PLAN OF TOP SECTION.



UPRIGHT SECTION.



GROUND PLAN.

OCTAGON CONSERVATORY IN ROYAL BOTANIC GARDENS, PERADENIYA, CEYLON.

posts. The whole structure is covered over with a 3-in. mesh wire-netting. Over the flat tops are placed split-bamboos, strung together like tats, and tarred. The handsome evergreen climber, *Passiflora laurifolia*,* is planted around the house and trained on the wire-netting of the upright portions, forming a useful and effective screen. The interior is occupied with graduated plant-stages on one side, and a broad sloping border on the other, the centre being furnished with five plant-stages, rising in tiers; all the paths and stages are of brick and cemented over. Here numerous shade-loving species thrive to perfection.

* Now replaced by *Ficus repens*, which answers the purpose even more satisfactorily.

An excellent and commodious shade-house or conservatory in the Maharaja's garden at Bangalore has tall stone slabs, easily obtained in the vicinity, instead of iron for uprights, and is covered with the creeper *Banisteria* (*Stigmaphyllon*) *laurifolia* over strong netted wires, supported by cross iron bars. A similar and very effective "conservatory" may be seen in the Royal Botanic Gardens, Calcutta.

Effective shade or screen for plant-houses may be provided by means of suitable evergreen climbers with small leaves, as *Ficus repens*. These should not, however, as a rule be permitted to grow over the roof, as they thus excessively reduce light and ventilation and interfere with the healthy growth of the plants. In India, strips of woven reeds placed on the roof are often used for shade, while in Ceylon special coir-netting or bamboo tats are generally employed for the purpose. In the hill districts, the growing of tender tropical plants can usually be carried on only by means of a greenhouse, though a well-protected or glazed verandah may answer the purpose to some extent. A greenhouse may be easily heated by a flue passing from a fire and stoke-hold outside to within, and then under the plant-staging. An excellent greenhouse, built on this principle, may be seen in Hakgala Gardens, Ceylon.

Propagating Frames. Glazed frames are most useful adjuncts to up-country gardens. These may vary in size according to requirements, and should always be movable, *i.e.* not fixtures. Bottom-heat may be provided for a propagating frame by means of a hot-bed made of fermenting horse-dung, the latter being heaped in a deep pit, covered with a layer of fine soil, and the glazed frame placed over it. (See p. 47.)

CULTIVATION OF POT-PLANTS

The successful cultivation of the choicer kinds of ornamental plants in pots is a branch of horticulture which demands special care and a certain amount of skill. A knowledge of the plants' requirements, gained by observation of their growth and habit, is the best guide in the matter. An important condition, both for the health and appearance of the plants, is cleanliness; therefore the foliage should be frequently syringed, occasionally sponged with soapy water if necessary, and the pots scrubbed to prevent the growth of moss or lichen.

Potting plants. The essential requirements for this operation are: clean earthenware pots, a suitable soil (see *Composts*), and small pieces of broken pots for drainage. Commencing with the latter, a crock (piece of potsherd) is placed, concave side down, over the hole in the bottom of the pot; around and over this are placed smaller crocks; a little dry moss, coir-fibre, or coarse grass should be placed over this to prevent the soil clogging the drainage. A layer of the potting compost being then filled in, the plant is placed in the centre, the soil filled in around it and pressed down firmly. A space of about ½ in. from the top should be left for the purpose of holding water when the plants are watered. It is sometimes customary to cover the surface of the soil in the pots with a layer of small pieces of porous brick or sandstone, closely and neatly packed. This has the effect of keeping the staging clean, preventing the soil from being washed out in the course of frequent waterings, while also checking the evaporation of moisture. After the plants are potted, a copious watering is given, and the plants are kept for a few days in a fairly dark room or under shade. A common error on the part of native gardeners is to use pots many sizes too large; these are not only ungainly, but also less suited to the health of the plants. The latter look and thrive best in pots which are in proportion to their size.

The proper time for potting should be determined by the progress of the plants and the condition of the soil and roots, rather than by any fixed seasons. Generally speaking, the best time is when the plants are commencing their more active periods of growth, which usually occur at the commencement of the monsoon rains.

The necessity for re-potting a plant may be ascertained by turning it out of the pot and observing the state of the roots, soil, and drainage. "It is a standing rule," said Sir Joseph Paxton, "with experienced horticulturists that no plant should be allowed a larger pot till the one in which it is growing is filled with fibrous roots," *i.e.* pot-bound. Frequently, however, before the pot is filled with roots the soil

becomes sodden or impoverished, with the roots in an unhealthy state, and the plant is unable to make normal growth. This condition is especially liable to be induced by the frequent watering necessary in the tropics, and when it occurs the soil should be entirely removed and replaced with a suitable potting mixture. Plants should never be re-potted when the soil is in a dry state. If in this condition, they should be watered some time before potting is commenced, so that the surplus water will have time to drain away. Soil used for potting should be sufficiently moist to hold together when pressed in the hand.

Drainage of Pot-plants. No point is of greater importance than proper drainage. The cause of sickly plants is to be found, in the majority of cases, in imperfect drainage, in consequence of which the soil becomes sodden and sour, affecting the functions of the roots. Whenever this condition is suspected, the plant should be gently turned out, the drainage replaced as above stated, and the soil renewed if necessary.

Soil for Potting Plants. The ideal compost for most plants should consist of rich loam, leaf-mould, and fine sand, made up in various proportions to suit the plants in hand. A peaty soil is especially suitable for many ferns and plants of the Rhododendron and Azalea family, though these may also thrive in rich loamy soils, which palms and most foliage plants prefer. **Loam** may be made by collecting turf from old pasture land, stacking it with grass-side down and placing layers of manure in between; this, if left for a year or more to decay, forms an excellent soil for composts. **Coir-dust,** if well leached, forms a fairly good basis, when loam is not procurable, for a potting mixture, adding to it some well-decomposed manure, leaf-mould and a little fine sand. (See *Organic Manures.*) In Colombo, for instance, this is often the only kind of potting soil procurable.

Earth-worms, Eelworms, Centipedes, etc. in Pots. An excellent remedy for these pests is Vaporite (see *Insecticides*), which should be in the possession of every gardener. It is a brown powder preparation and may be applied in a weak solution with water (say, a dessert-spoonful to a gallon of water), or merely sprinkled dry on the surface of the soil before watering. Lime-water or soot-water, though not so effective, may also be employed for the purpose. A good plan is to stop the hole of the pot with clay for a few hours, so that the whole of the soil may become saturated with the solution. (See *Enemies of Lawns.*)

Watering is one of the most important operations connected with the cultivation of pot-plants, for a deficiency or excess of water at the roots (see *Drainage*) is a frequent cause of languid growth or disease. To know just the proper amount of water that is most beneficial to a plant requires judgment, and can only be learnt by observation of the plant's progress.

Water should not be given unless required, and then only in sufficient quantity. A sharp tap on the pot will indicate by the sound whether a plant is dry at the root and in need of water. If the soil is in a very dry state, the plant with the pot should be placed for a time in a bucket of water to become thoroughly soaked. When the leaves droop, it is a sign that the plant is either in need of water or is suffering from soil stagnation at the root. Water should not be allowed to remain in the saucers or vases in which plants are standing, for this will cause a stagnant condition of the soil, besides affording a breeding ground for mosquitoes. A watering-can with a rose should always be used, especially for young or delicate kinds; but it must not be forgotten that this affords a dishonest gardener a greater opportunity for scamping the work than watering through the plain spout. The best roses are those made of brass with fine regular holes. Only those with the smallest holes should be used for watering seeds in boxes or beds. One of the most important lessons to teach a garden coolie is that watering, if needed at all, must be plentiful, and that a mere wetting of the surface is deceiving. All watering should, if possible, be done late in the afternoon or in the early morning. Always use *soft* rain- or pond-water, if procurable, in preference to well-water, which is *hard.* Water mixed with a weak solution of liquid-manure is beneficial to most plants.

Absorption of Water. Plants vary in their capacity for drawing moisture from the soil, *i.e.* some have more rapid transpiration than others. Those with a thin epidermis take up relatively a large amount of water; while others of a succulent nature, such as Cacti, Agaves and Aloes, have a thick cuticle (*xerophytic*) and take up comparatively very little. The latter are thus able to thrive in dry arid regions. Vigorous-growing plants naturally require more water than slow-growing kinds, owing to their more rapid transpiration. Deciduous plants, when they have shed their leaves, should be watered but sparingly, as, owing to their transpiration surface being then reduced to a minimum, much moisture at this stage is injurious to them. During wet weather, evaporation from the leaves is reduced; therefore plants take up less water by their roots, while in dry weather these processes are reversed. Plants give off moisture more rapidly when exposed to wind or sunshine than when growing in shelter or shade, and therefore require more water at the root. When the roots are confined in a small space, there is naturally a great demand on the supply of water available, and plants in this condition require frequent and copious supplies. The principle of the above remarks apply to all classes of plants, trees and crops.

Syringing is very essential to the health of plants growing under cover, where the natural rain does not reach them. Syringing creates a moist atmosphere, cleanses the leaves, and thus assists in promoting their functions as well as in their presenting a cleaner and finer appearance. In dry weather, the syringing of plants, which should only be done with perfectly clear water and through a fine syringe-rose, may with advantage be carried out twice or three times a day, provided the plants are shaded. During wet and dull weather, however, it should be done sparingly, if at all.

VERANDAH-GARDENING

An essential feature of horticulture in the tropics is what may be called verandah-gardening, which in some cases, especially in towns, may cover the entire gardening scope of a bungalow. Nothing brightens a bungalow so much as a verandah furnished with well-grown and choice plants, and these may be considered almost as indispensable to a verandah as the latter is to a bungalow. As window-gardening is now a prominent feature in many towns in temperate countries, being encouraged by municipalities and sometimes supervised by tasteful women, the attention of municipal authorities in the tropics might well be directed to the encouragement of verandah-gardening in towns.

The successful growth of plants in a verandah depends to some extent on aspect and situation. Many beautiful foliage plants, which become stunted or scorched by the sun on the south side of a bungalow, may grow luxuriantly in a shady north verandah. Ferns are generally best suited to a shady northern aspect. It is often advisable, however, to change the plants occasionally, as may be gauged by their indifferent or unevenly developed growth, from north to south or *vice versa.* All plants growing in a verandah should be frequently turned round in their position, so as to equalise the effects of light, otherwise their growth will be one-sided. Over-crowding of the plants should always be avoided, for space as well as cleanliness is essential to their well-being. The foliage should be syringed frequently, and all dead, sickly or superfluous growth removed. The pots or tubs should not be ungainly in size, or of grotesque appearance, and should be raised off the ground and placed on neatly arranged and concealed bricks.

Drawing-room plants. Everybody experiences at one time or another the difficulty of keeping plants in good condition in a room, for, however carefully tended, these sometimes sicken or become discoloured. Frequently the cause is excessive watering (see *Watering*), but it may also be due to insufficient daylight or excessive artificial light. Therefore, the plants should be placed out of doors at night and during the early

part of the day, especially during rainy weather. This has also the effect of keeping the foliage clean and healthy.

Selection of Plants for Verandahs. Certain plants are more adapted for growing under cover than others. Thus, in a selection for the low-country, foliage plants, such as Ferns, Begonias, Palms, etc., should predominate; while for higher elevations flowering annuals or perennials, hardy ferns, etc., may be included. The following indicate the kinds chiefly suited in either case. For the low-country: Feathery palms, such as *Chrysalidocarpus* (Cane-palm), *Caryota* (Kitul), *Ptychosperma, Phoenix*, and *Cocos*; Fan-palms, as *Licuala grandis, Livistona, Thrinax, Latania*, and *Sabal*; also *Anthuriums, Alocasias, Begonias, Marantas, Ferns, Caladiums, Ophiopogon*, etc. For up-country: *Pelargoniums, Geraniums, Petunias, Begonias, Primulas, Gloxinias, Cinerarias, Chrysanthemums, Fuchsias, Cyclamens, Gesnerias, Streptocarpus, Bouvardias, Adiantum* (Maiden-hair) and other ferns, etc. (See p. 193.)

FRENCH OR INTENSIVE GARDENING

It is well known that in France and certain other countries is practised a system of close intensive cultivation of the soil. The term is a broad one, but the general principle is based on getting the most out of the soil in the shortest time possible, procuring crops at the most profitable seasons, and wasting no more space or crop than is unavoidable.

Thus, in economising space, the paths are generally very narrow, and planting distances are regulated by measured boards or by a definite scale. Quick-growing crops are interplanted with those of slower growth, so that the former may be reaped before the latter have attained maturity, and without interfering with the growth of either. By means of hot-beds and cloches, certain vegetables and salads are produced throughout the winter and spring, when, being "out of season," they command remunerative prices.

SECTION II

CHAPTER XI

BEAUTIFUL TREES OF THE TROPICS

SUITABLE FOR LOW OR MEDIUM ELEVATION

THOSE IN LARGE TYPE ARE OF CHIEF IMPORTANCE

FLOWERING TREES:

STRICTLY speaking, all trees bear flowers, that is, they normally produce flowers, whether these be showy or inconspicuous; but, for practical purposes, only such as bear conspicuous or showy flowers and are commonly known as *flowering* trees are here included. For trees whose beauty consists chiefly in their foliage or form, see *Ornamental Foliage Trees.* Many of the following species, however, combine to a large extent both beauty of foliage and flowers. Some flowering trees are deciduous and develop their floral display when devoid of leaves (*e.g.* Red Cotton Tree, or *Bombax*), while others are in their full glory of foliage and blossom simultaneously, as *Amherstia, Spathodea*, etc. Certain flowering trees may be employed for utility as well as for ornament, as for shade along exposed thoroughfares or in parks, etc. The planting of bright flowering trees around bungalows situated in lonely districts and surrounded by monotonous plantations would go far to relieve the depressing effect often inseparable from such situations.

Flowering Trees for Street-planting, etc.—For this purpose a flowering tree should obviously be evergreen, or at least have the habit of developing young foliage soon after the shedding of the old leaves. (See selections, pp. 209–216.) If the name of the tree employed is such as to lend itself to use as a street name, it might be so adopted; for while thus impressing the charm of the tree, the name itself might be an improvement on some of the street names now in use, *e.g.* "Amherstia-avenue," "Cassia-terrace," "Brownea-grove." To this, however, there may be certain objections. The following are some of the most beautiful flowering trees of the tropics, given in alphabetical order. By coincidence, the first on the list is perhaps the finest flowering tree in the world.

Amherstia nobilis. "Queen of flowering trees." *Leguminosae.* Named after Lady Amherst, whose husband was once Governor of Burma. —A medium-sized tree, native of Burma, considered the most beautiful of all flowering trees. Its large, graceful sprays of vermilion and yellow flowers, drooping from every branch and interspersed with the handsome foliage, present an appearance of astonishing elegance and loveliness. It is in blossom for the greater part of the year, except during long periods of rainy weather, the chief flowering season in Ceylon being from November to April. The tree grows to a height of 50–60 ft., is usually round-topped, with many slender branches and large, dark-green, pinnate leaves.

A remarkable feature is the long, brownish-pink drooping clusters in which the young leaves appear. This habit is also characteristic to some extent of certain other tropical trees, e.g. *Brownea grandiceps* and *Saraca declinata*. In the latter case the young leaves are mottled pale grey or almost white. (See *Coloration of Flowers and Leaves.*)

The Amherstia thrives in the moist low-country up to 1,600 ft., and requires deep, rich and well-drained soil. It does not seem to flourish near the sea, and is rarely met with about Colombo. It produces seed very scantily anywhere, a pod or two (which are flat, brown, 6–8 in. long, containing one to three large flat seeds) occasionally being all that can be obtained. The seeds, moreover, are often infertile. Propagation by layering has therefore to be adopted (see *Gootee*). Introduced to Ceylon in 1860. (See *frontispiece.*)

Brassaia actinophylla.
Showing striking inflorescence of radiating crimson spikes.

Baikiaea insignis. *Leguminosae.* An ornamental flowering tree, reaching a height of 40–50 ft., with large coriaceous, oval leaves, native of W. Trop. Africa. Bears large, flaccid, white flowers, opening in evening and fading the following afternoon, chiefly about April–May and August–September. The large flower-buds are black and velvety. Introduced at Peradeniya in 1902, and bears seed occasionally.

Bauhinia. *Leguminosae.* A genus including several small but beautiful flowering trees, as *B. purpurea* with very showy large flowers of a pink shade merging into purple; *B. triandra* or Mountain Ebony, similar to the latter; *B. tomentosa* (Kahapetan, *S*) with yellow flowers; *B. variegata*, with large magenta and white flowers; *B. Krugii* of Porto Rico, and *B. monandra* of Burma, and others. The genus takes its name from Bauhin, the twin brother botanists, from the fact that the leaves are joined in twos at the base. It also includes shrubs and climbers.

Bolusanthus speciosus. Rhodesian Wistaria; M'pakwa, M'poea, or Maawthlu. *Leguminosae.* A beautiful tree of Rhodesia, N. Transvaal, etc. bearing drooping racemes of deep blue, scented flowers, resembling those of the Wistaria. It is a slow grower and has glossy dark-green small pinnate leaves, which are briefly deciduous. Said to be one of the most ornamental trees of sub-tropical S. Africa. Grows up to 3,000 ft. in Rhodesia.

Bombax malabaricum. *Bombaceae.* Red Cotton Tree; Katu-imbul, *S*; Parutti, *T*. A very large, stately, upright, quick-growing, deciduous tree, reaching a height of 120 feet or more, native of Ceylon, India, Burma, etc. It is a striking sight when covered with its large, fleshy, bright red flowers, usually during January and February, when quite leafless. The flowers are edible and, as they drop, form a scarlet carpet on the ground for 2–3 weeks. The tree forms a large straight trunk which, consisting of soft wood without heartwood, is often hollowed out and used for making native canoes with outriggers. The chief use of the wood in Ceylon is for making tea-boxes (which see). In India, it is said to be suitable for making matches. (See *Fibres.*)

Brassaia actinophylla. *Araliaceae.* A small, soft-wooded, sparsely branched tree, with large, handsome, radially-divided leaves, native of

Brownea macrophylla.
Bright rose. Showing flowers, flower-buds, pods and seeds.

Queensland, introduced to Ceylon in 1873. The remarkable terminal inflorescence consists of several radiating spikes, each 3 to 4 ft. long, deep crimson in colour. (See also *Fol. Trees.*)

Brownea ariza. *Leguminosae.* A small spreading tree with pinnate, drooping leaves, native of Tropical America, introduced to Ceylon in 1884. It bears from the ends of the branches large, dense, round clusters of blossom, resembling in form large Rhododendron flowers, being bright scarlet in colour.

B. coccinea (Scarlet). A short spreading tree, native of Tropical America and introduced into Ceylon in 1849. It is distinguished from the other Browneas by having the flowers in small scarlet clusters, produced in large numbers along the stem and older branches.

B. grandiceps (Large-headed). Rose-of-Venezuela. A larger and more handsome species than either of the former, reaching a height of 30 or 40 ft., native of Venezuela, introduced into Ceylon in 1870. A very beautiful tree when in full blossom, the bright red flowers being borne in large dense heads at the ends of the branches. The foliage, too, is very handsome, the young mottled pinnate leaves being produced in long, drooping, flaccid bunches, similar to those of Amherstia.

"Rose-of-Venezuela" (*Brownea grandiceps*).
Showing large scarlet clusters of flowers.

B. macrophylla (large-leaved).—A strong-growing species of Colombia, introduced into Ceylon in 1894. It is of a less free-flowering habit than the three foregoing species, but the flower-heads are larger, of a bright rose shade, with long, protruding, bright-coloured stamens, which distinguish it from the other species.

B. Crawfordii, a hybrid between the latter two species; bears large, handsome, salmon-pink flowers, each cluster containing 60–70 florets.

Butea frondosa. *Leguminosae.* Flame of the Forest; Bengal Kino; Dhak; Tissoo; Pulas; Gaskela, *S*; Parasu, *T*. An erect tree with large, leathery, broad, trifoliate leaves, indigenous to the forests of the drier parts of Ceylon, India, and Burma; reaches a height of about 40 ft., and bears in the dry months a profusion of beautiful crimson or orange-scarlet flowers. The tree furnishes a resin

(kino), and a useful fibre from the bark; lac is produced on the young twigs (see *Lac*), and the flowers yield yellow and orange dyes.

Cassia Fistula. *Leguminosae.* Indian Laburnum; Pudding-pipe; Purging Cassia; Ehela, *S*; Tiruk-kontai, *T*. A small upright tree, common in the forests of the drier parts of Ceylon and India. A beautiful object when in blossom, bearing masses of yellow flowers in pendulous racemes, suggesting the Laburnum. The flowers are used as temple offerings, and the astringent bark for tanning and in native medicine. The black cylindrical pods grow to a length of from 20 to 30 in.; the pulp of these is a well-known purgative (see *Med. Plants*). Suited chiefly to a semi-dry region, but in well-drained soil will thrive in moist districts up to 2,000 ft. Its chief drawback for ornament is the native habit of stripping off the fresh bark for use in their medicine.

INDIAN LABURNUM (*Cassia Fistula*). Long pendulous, yellow racemes.

Cassia grandis (Great). Horse Cassia. A spreading tree, native of S. America, attaining a height of about 40–50 ft.; bears a profusion of pale pink inflorescence during the dry months of February or March, when the tree is completely deciduous. It produces in June an abundance of thick, coarse-skinned and slightly curved pods, the pulp of which has an offensive odour.

HORSE CASSIA (*Cassia grandis*). Bright pale pink.

C. javanica. A medium-sized tree of Malaya, similar to *C. nodosa*, but differs in having the inflorescence more dispersed among the leaves, and in the sepals being brown or purple, not green.

C. marginata (marginated leaf). Ratu-wa, *S*; Vakai, *T*. A small, graceful tree with spreading, drooping branches, common in the dry region of Ceylon and S. India; very ornamental when bearing its racemes of rose-coloured flowers, usually in July–August.

C. moschata. Upright tree, 40–50 ft. high, native of Trop. America. Flowers in pendulous racemes, orange to salmon-pink,

CASSIA NODOSA, Ham.

PINK CASSIA.

Cassia moschata. Salmon-pink.

in season during March or April. Pods smooth, cylindrical, 14–18 in. long, rather like those of *C. Fistula*.

C. multijuga (many-pinnae). A slender, brittle, quick-growing tree of Trop. America, introduced into Ceylon in 1851. Very ornamental when in full blossom, usually during August-September, being practically smothered with very large, erect panicles of bright yellow flowers, suggesting a glorified Calceolaria. The tree luxuriates in the moist climate of Peradeniya, but rarely produces seed here. At Anuradhapura, however, in the drier region, it bore fruit abundantly in the former botanic gardens. It does not form a shapely tree, and may with difficulty be propagated by cuttings.

C. nodosa (knotted, referring to the knotted stems). Pink Cassia. A moderate-sized upright tree, native of E. Bengal and Malaya; very beautiful when bearing in profusion its bright-pink and rose-scented flowers, in large sprays, during May and June. The flowers are followed by cylindrical pods, 12–15 in. long. The tree is deciduous for a short period in the dry weather. (See coloured block.)

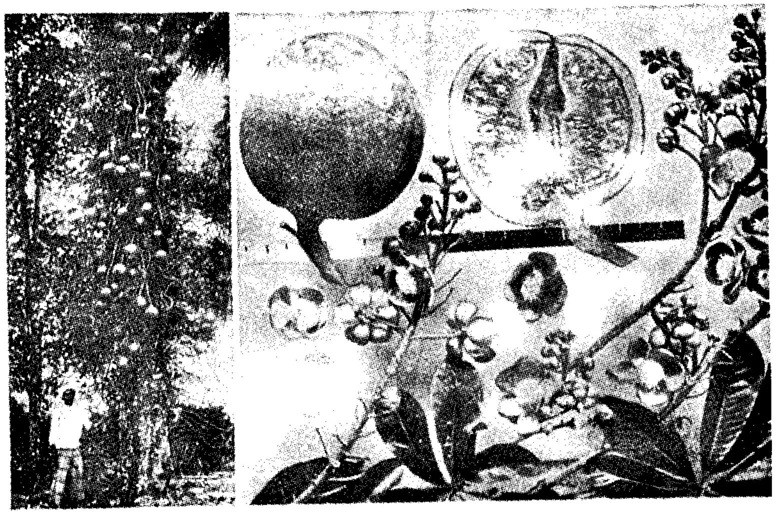
Cassia multijuga. Bright yellow.

Cassia nodosa. Bright pink.

Cochlospermum gossypium. *Bixaceae.* Katira; Kinihiriya or Ela-imbul, *S*; Kongu, *T*.—A rather small tree, native of Central India, semi-naturalised in parts of the southern dry region of Ceylon and often planted near Buddhist temples. A beautiful tree when in blossom (chiefly in February or March), with its large, bright yellow solitary flowers, which are esteemed as temple offerings. The tree is deciduous in the dry weather; thrives best in moderately dry districts.

Colvillea racemosa. *Leguminosae.* Named in honour of Sir Charles Colville, once Governor of Mauritius. A medium-sized tree, 50–60 ft. high, with handsome pinnate leaves, native of Mauritius and Madagascar. It bears in September large, erect, close racemes of bright scarlet flowers, presenting a very showv appearance. Suited to the moist or moderately dry low-country.

Cordia Sebestina. *Boraginaceae.* Sebestens; Lolu, *S*. A small ornamental tree or large shrub, with large ovate, pointed leaves. Flowers funnel-shaped, orange-red or scarlet, in large terminal clusters. Best suited to dry districts. W. Indies, etc.



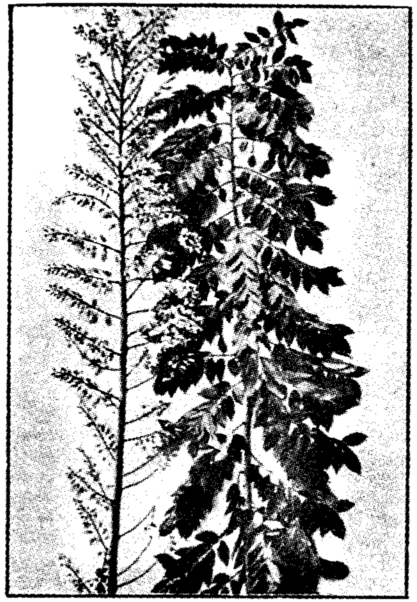
CANNON-BALL TREE (*Couroupita guianensis*).

Couroupita guianensis. *Myrtaceae.* Cannon-ball Tree. A remarkably striking tree when bearing its long woody racemes (4–6 ft. in length) of large pink-and-white, fleshy, curious flowers, crowded along the trunk from the base upwards. The large brown globular fruits, which attain the size of the human head and contain a mass of very sour-smelling pulp, take 8–9 months to ripen. The tree is a native of Trop. S. America; was introduced into Ceylon in 1881, where it has flowered and fruited regularly since 1898, when it flowered here for the first time. Moist low-country. Prop. by seed.

Derris dalbergioides. *Leguminosae.* A tall erect tree with fine feathery foliage. Deciduous for a brief period in Feb. or March, after which it bears at the ends of the branches masses of purplish-pink blossom, rendering the tree a striking object. The blossom, however, is soon over.

Erythrina indica. *Leguminosae.* Erabadu, *S*; Mullu-murukku, *T*. Thorny Dadap. A medium-sized, quick-growing tree with large trifoliate leaves; deciduous in dry season, unless pollarded. The scarlet flowers are borne in tufts at the tips of the branches when the latter are bare of leaves, in the dry season. Sometimes

grown as supports for pepper vines, etc. Prop. by cuttings or seeds; stems of considerable size are capable of striking root if planted in moist soil.



1. 2.
Gliricidia maculata. Madera.
(1) Flowering shoot; (2) foliage shoot.

Gliricidia maculata. *Leguminosae.* Madera, or "Gliricidia," of Trop. America.—A small, quick-growing tree, introduced to Ceylon from the W. Indies about 1889. Bears long, arching, feathery, leafy branches, which in the dry weather drop nearly all their leaves and produce along the greater part of their length masses of purplish-pink flowers, making the tree a striking object for a few weeks. There is also a variety with pure white flowers. Thrives from sea-level to about 3,000 ft. or higher. Its rapid growth and long, leafy numerous branches commend it as a shade and green-manure tree for crops. Trees at Peradeniya Experiment Station each averaged 140 lb. of green loppings a year, against 90 lb. for Dadap. The whole tree is rich in nitrogen, the flowers alone containing up to 3·36%. The dried leaves smell like new-mown hay. About 2,000 of the seeds go to a lb. The tree forms a good support for Vanilla vines, and is best prop. by large cuttings (5–6 ft. long) planted *in situ* at distances of about 12 ft., according to requirements. (See *Shade Trees*, p. 211.)

Jacaranda mimosaefolia. *Bignoniaceae.* A very elegant tree on account of both leaves and flowers, native of Trop. America and introduced into Ceylon in 1886. It reaches a height of 40–50 ft., and bears at various seasons a profusion of mauve or bluish-purple bell-shaped flowers. The elegant bipinnate mimosa-like leaves make the seedlings well worth growing as small ornamental foliage plants for pots. The tree is suited to a rather dry as well as moist climate, and thrives in warm sub-tropical countries. *J. filicifolia* also is remarkable for its delicate fern-like foliage, especially in the young state. *J. micrantha* is a more robust species with larger leaflets, producing large loose sprays of bright purplish flowers.

JACARANDA (*Jacaranda mimosaefolia*).
Flowers bluish-purple or mauve.

Kleinhovia hospita. *Sterculiaceae.*—A large, spreading Malayan tree with heart-shaped entire leaves, introduced into Ceylon about 1820. It bears large terminal panicles of pink or rose-coloured flowers, chiefly during July to August. Thrives in the moist low-country.

Lysidice rhodostegia.
Flowers rose-purple, in large panicles.

Lagerstroemia Flos-Reginae. *Lythraceae.* Queen Flower; Pride-of-India; Murutu, *S.*—A medium-sized spreading tree, native of Ceylon, India and Malaya. This is undoubtedly one of the most strikingly showy of flowering trees, and from April to July or later bears from the ends of the branches large, erect panicles of beautiful mauve or pink flowers. The older trees are deciduous for a short period during the dry weather. There are two or more varieties, which vary in shades of colour; that with bright pink flowers is especially attractive.

L. tomentosa. Leza.—A moderate-sized handsome tree, native of hot and moist parts of Burma, introduced into Ceylon in 1891. It blossoms twice a year, in April and October, bearing large erect panicles of white flowers, produced from the ends of the branches.

Lysidice rhodostegia. *Leguminosae.*—A large handsome tree, with pinnate leaves, native of S. China, introduced into Ceylon in 1882; thrives in the moist low-country of Ceylon and bears, usually in January–February, erect loose panicles of rose-purple flowers with pale pink scale-like bracts. These are followed by thin, flat, brown pods, about 5–6 in. long,

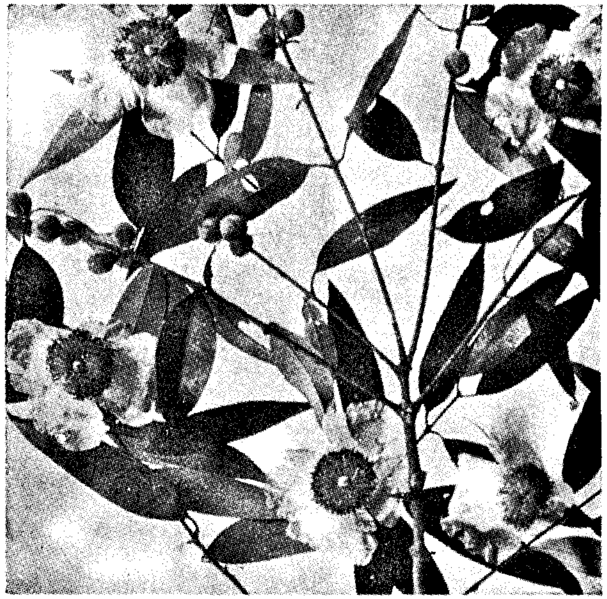
PRIDE OF INDIA, QUEEN FLOWER (*Lagerstroemia Flos-reginae*).

Lagerstroemia tomentosa.
Flowers in large white masses.

containing flat brown seeds. The persistent coloured bracts remain long after the flowers have dropped.

Millingtonia hortensis. *Bignoniaceae.* Indian Cork-tree.—An erect tree with light feathery foliage (2–3 pinnate), reaching a height of 60 ft. or more; bears twice a year, chiefly in November and June, a profusion of long, tubular, pure-white fragrant flowers. A favourite tree in Indian gardens; thrives from sea-level to medium elevations in Ceylon. Often planted in avenues in India. (See *Trees for Dry Districts.*)

Mesua ferrea. *Guttiferae.* Ceylon Ironwood; Mesua; Na-gaha, *S*; Naka, *T.*—A moderate-sized or tall, broad, conical, slow-growing, handsome tree, native of the hot and moist regions of Ceylon, India and Malaya, often planted near Buddhist temples. It blossoms profusely in April–May, the large white flowers, each with its large bunch of yellow stamens, being delicately scented. The young leaves, which appear twice a year, are deep crimson, rendering the tree a striking object. (See *Foliage Trees.*)



CEYLON IRON-WOOD TREE (*Mesua ferrea*).
Flowers large, white with yellow centre.

Monodora tenuifolia. *Anonaceae.* Orchid-flower Tree. A small deciduous tree, flowering profusely in the dry season when devoid of leaves. The three enlarged wavy sepals are dull yellow, blotched with brown, suggesting an orchid flower.

Oncoba spinosa. *Bixaceae.* A small bushy tree of Arabia, with light green, small, ovate leaves. Bears during April–May, from the underside of the young branches, large, solitary, white, scented flowers with numerous yellow stamens. Introduced into Ceylon in 1883. Bears during July–September round, smooth green fruits, which are considered edible.

Orchipedia (Portia) grandiflora. *Apocynaceae.* A small spreading tree, with opposite leaves and bi-forked branches, native of Java. Bears in September–October a profusion of creamy-white flowers, with five contorted petals and a strong starchy odour.

Pachira insignis. *Bombaceae.* A medium-sized tree of Mexico, with large, palmately-divided leaves and large, fleshy, white and pink fugacious flowers, the long ligular petals being uniformly recurved. The pod-like fruits are 8–10 in. long. Introduced into Ceylon in 1888. See fig. on p. 88.

Peltophorum ferrugineum. *Leguminosae.* Iyavaki, *T.*—A large quick-growing, symmetrical tree, with a spreading top and fine bipinnate leaves, indigenous to Ceylon and Malaya. It blossoms twice a year at irregular seasons, some specimens being in blossom while others by their

Oncoba spinosa.
(See p. 87.)

CRIMSON TEMPLE-TREE (*Plumeria rubra*).
(See p. 89.)

Pachira insignis.
(See p. 87.)

Peltophorum ferrugineum.
(See p. 87.)

side are in ripe fruit. The flowers are rusty-yellow, sweet-scented, and borne in large, erect panicles. The young leaves and shoots are covered with a brown tomentum. "A magnificent sight when in full blossom" (Trimen). Suited to dry as well as moist region, up to 2,000 ft.

Plumeria acutifolia. *Apocynaceae.* Temple-tree; Pagoda-tree; Frangi-pani; Araliya, *S.* A low, spreading, semi-succulent, milky tree or large shrub, originally introduced from Trop. America. It is a familiar tree in the Eastern tropics, especially throughout the low-country of Ceylon, being often planted near Buddhist temples. Stands the sea breeze well. The tree is almost or quite bare of leaves in the dry season, when it bears large heads of white (with yellow centre) and highly fragrant flowers, followed occasionally by a few bifurcated pods. Easily prop. by cuttings.

P. rubra. (Red.) A tree similar to the latter, bearing bright crimson flowers in profusion, also a few fruits occasionally; native of Cent. America, first introduced into Ceylon in 1900. Very showy; continues flowering for several months. Large cuttings strike root readily.

GOLDEN MOHUR or GULI-MOHUR; Flamboyante (*Poinciana regia*).
1, scarlet fl's.; 2, pod; 3, fine feathery lvs. (See coloured block.)

Poinciana regia. *Leguminosae.* Flamboyante; Flame Tree; Golden Mohur or Guli-mohur (flower-of-gold, in reference to the Indian gold coin "mohur"). A gorgeous tree when in full blossom, bearing immense sprays of scarlet or orange flowers; native of Madagascar, introduced into Ceylon before 1841. It is a very striking object about Colombo during the months of April and May; grows from 40 to 50 ft. in height, with a spreading habit, and has very handsome, fine, feathery, long, bipinnate leaves. Almost deciduous for a short time in dry season. Suited to moist as well as dry regions, especially near the sea. Cultivated in all tropical countries. There are at least two distinct varieties, that with flowers of a bright orange shade being especially attractive. (See coloured illustration, also fig. above.)

Posoqueria longiflora. *Rubiaceae.*—A moderate-sized, quick-growing evergreen tree, with large, deep-green leaves, native of Trop. Amer., producing long, tubular, white and scented flowers in pendulous clusters, usually during May and September. Suited to moist districts up to about 2,000 ft.

Pterocarpus echinatus. *Leguminosae.*—A moderate-sized tree, native of the Philippines, introduced into Ceylon in 1882; bears large clusters of pale orange-yellow flowers during April or May, followed by circular, prickly, winged pods. Very ornamental when in blossom.

Saraca declinata. *Leguminosae.* A small tree of Sumatra, introduced to Ceylon in 1870, producing along the stem and older branches large heads of bright orange-yellow flowers, usually during February or

March. Bears a few, flat, bright red pods. Prop. by seed. Thrives best in shady and sheltered situations. A striking tree when in flower.

S. indica. Diya-ratmal or Diya-ratambala, *S*; Asoka Tree of India. A small, spreading tree, native of Ceylon and S. India, bearing on the stems and branches, chiefly in the dry weather, large sessile clusters of scented flowers (suggesting an Ixora) which change from yellow to orange and red. The young leaves are developed in long, drooping greyish-white bunches, as in Brownea and Amherstia. Thrives in shady situations, especially near water, in the wet or semi-dry districts.

Saraca declinata.
A beautiful flowering tree, showing large clusters of bright orange inflorescence.

Schizolobium excelsum. *Leguminosae.*—A very large, quick-growing, magnificent tree, with fine, bipinnate, long feathery leaves; native of Brazil. Introduced in 1872 at Peradeniya, Ceylon, where it luxuriates, blossoming and fruiting regularly. The bright yellow flowers are borne in very large, semi-erect sprays, during February or March, when the tree is bare of leaves. Moist low-country.

Potato Tree (*Solanum macranthum*).

Solanum macranthum. *Solanaceae.* Potato Tree.—A quick-growing and soft-wooded tree of Brazil, reaching a height of 30 ft. or more, first introduced into Ceylon in 1844. The large purplish-blue and white flowers, with conspicuous yellow anthers, resembling the potato flowers, and the large, deeply cut, prickly leaves render it a very ornamental tree. Thrives best in sheltered and partially shaded situations, up to about 3,000 ft., or higher if not exposed to strong winds. Propagated by seed or cuttings. This is probably the only species of the Potato family that grows into a tree form.

Spathodea campanulata. *Bignoniaceae.* Fountain Tree; Tulip Tree.—A tall, erect tree of W. Trop.

Spathodea campanulata.
Young tree, showing scarlet flowers at top.

Africa, introduced into Ceylon in 1873, now commonly planted about Kandy and elsewhere for shade or ornament. The large, bright orange-scarlet, erect cup-shaped flowers, produced at the tips of the branches throughout the wet season, render the tree strikingly handsome and conspicuous at a distance. The unexpanded flowers contain a quantity of secreted water, hence the common name. Thrives up to 4,000 ft. and is suited to fairly dry districts. The tree is soft-wooded, old specimens becoming hollow in the centre and therefore dangerous near buildings or roads. Propagated by seed or cuttings.

S. nilotica. Kifabakazi. A tree of E. Trop. Africa, similar to the above but with flowers of a brighter orange-red. It blossoms freely when only 3–4 years old, and sets fruit at low elevations. Introduced into Ceylon in 1910.

Stenocarpus sinuatus. *Proteaceae.* Fire Tree or Tulip Tree of Queensland. (See *Flowering Trees for Up-Country.*)

Sterculia colorata. *Sterculiaceae.* Kenawila, *S*; Malaiparutti, *T*. A moderate-sized tree, 40–50 ft. high, indigenous to the eastern dry region of Ceylon, but thrives also in moist districts. The brilliant orange-scarlet flowers, appearing in great profusion when the tree is leafless (February–March at Peradeniya), render the tree a conspicuous object. The Veddas (aborigines of Ceylon) sing odes to it. (Trimen.)

S. Balanghas (Nawa of Ceylon) and other species are, besides being of symmetrical shape, remarkable on account of their fruit, the bright orange carpels opening when ripe and exposing large jet-black shiny seeds, which remain adhering to the edges of the carpels after the fruit opens. (See *Curious Fruits.*)

S. lanceolata. A small or medium-sized tree of Java, S. China, etc., with rather small lanceolate leaves, very ornamental when bearing (usually in April–May) in profusion its bright orange-scarlet fruit, consisting of a cluster of five follicles. The latter spread out horizontally, opening on the under side and displaying the large, shiny, black seeds adhering to the margins of each follicle. Introduced at Peradeniya in 1898.

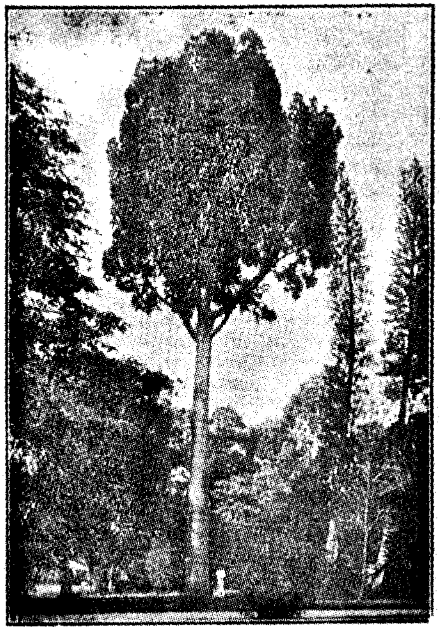
S. diversifolia. Bottle Tree or Kurrajong of Queensland, etc. Remarkable for the shape and size of its trunk, contracted at the top and bottom, which gives it the appearance of a bottle.

Tabebuia rosea.
Flowers bright mauve, in great profusion.

Stereospermum xylocarpum. *Bignoniaceae.* Padri-tree of India. A large spreading tree with small pinnate leaves, native of S. India, deciduous for a short period in the dry weather. It bears for 2–3 weeks a profusion of white, bell-shaped flowers. Low-country, moderately dry or moist parts.

Tabebuia rosea. *Bignoniaceae.* A small or medium-sized erect tree of Mexico, palmately 5-leaved (leaves entire in young state), producing after the dry season masses of lovely pale mauve flowers. A beautiful tree when in blossom, which unfortunately is soon over. Rarely bears seed at Peradeniya.

T. spectabilis. A small 5-foliate tree of Venezuela and the W. Indies, introduced into Ceylon in 1881. For a short period in March or April, when bare of leaves, the tree is a beautiful sight, being literally covered with masses of bright yellow, bell-shaped flowers, which, as they drop, form a golden carpet on the ground. Thrives at Peradeniya (1,500 ft.), but as yet only rarely produces seed here.



Kauri Pine (*Agathis robusta*). Right, *Araucaria Cookii.*

Warszewiczia coccinea. *Rubiaceae.* Chaconia; Wild Poinsettia. A slender, much-branched, small tree of the W. Indies. It produces large sprays of showy vermilion inflorescence, the attractive part of which is an enlarged sepal of each flower. Rare outside its native habitat. Introduced to Ceylon in 1923.

ORNAMENTAL FOLIAGE TREES

SELECTION SUITABLE FOR LOW OR MEDIUM ELEVATIONS

Agathis (Dammara) robusta. *Coniferae.* Queensland Kauri-Pine. A tall stately tree with a straight smooth stem, native of Queensland, introduced to Ceylon in 1865. Some very fine specimens may be seen in Peradeniya Gardens and on Pitakande Estate, Matale, which occasionally bear cones and fertile seeds. Thrives from 1,500 to 4,000 ft.

A. australis. New Zealand Kauri. A handsome tree, similar to the above, requiring sub-tropical conditions; yields valuable timber and Kauri-gum in its native home, where some 15,000 tons of the gum are collected annually for the extraction of oil. The latter yields a motor spirit and turpentine.

Agrostistachys Hookeri. *Euphorbiaceae.* Maha-beru or Diya-beru, *S.* A small, sparsely branched tree, with a crown of very large handsome lanceolate, crowded leaves, 18–24 in. long. Endemic but rare in Ceylon; moist low-country.
A. longifolia. Beru, *S.* An up-country shrub, with large, stiff, leathery leaves up to 2 ft. long, which are sometimes used for thatching, being remarkably durable.

Ailantus excelsa. *Simarubaceae.* Tree-of-Heaven, and *A. malabarica* (Kumbalu, *S*; Peru-maram, *T*) of Ceylon, India, etc. Large, handsome, quick-growing trees with large, pinnate leaves, 3–4 ft. long. Both are striking trees for landscape effect. Wood light, soft and spongy; the latter species yields a gum in India. Best suited to medium elevations.

Araucaria Bidwillii. *Coniferae.* Bunya-bunya Pine; Monkey-puzzle. A tall tree of Queensland, where it is said to attain a height of 150–200 ft., introduced to Ceylon in 1848. It usually bears branches down to near the ground. The small leaves are stiff and closely set, ending in a sharp point, hence the popular name. Thrives but does not bear fruit at Peradeniya. The Araucarias are a very handsome group of evergreen trees.

A. Cookii. A very tall, conical tree, with short, slender horizontal branches, native of New Caledonia, introduced to Ceylon in 1865. Here it has so far reached a height of about 140 ft., but does not produce fertile seed. Commonly grown in the young state as an ornamental pot-plant, being propagated from seed.

A. Cunninghamii. Moreton Bay- or Hoop-Pine. A tall handsome tree of E. Australia and New Guinea, said to attain a height of 200 ft.; introduced into Ceylon in 1848. It is distinguished from *A. Cookii* by its more spreading and horizontal branches, also by the fruit, etc. Not yet fruited at Peradeniya.

Artocarpus Cannoni (= **A. laciniatus**). *Urticaceae.* A medium-sized tree of the Society Islands. The large oblong leaves are purplish-bronze, especially in the young state, on account of which small plants are sometimes cultivated for ornamental purposes in hot-houses. Introduced to Ceylon in 1906.

A. incisa. Bread-fruit; Rata-del, *S.*—A very handsome quick-growing tree, with large, palmately-cut, shiny leaves, native of the Pacific Islands. It grows to a height of 50–60 ft., and few trees present a more noble appearance. (See *Trop. Fruits.*)

A. nobilis. Wild bread-fruit; Del, *S.*—A noble spreading tree with large, wavy or crinkled, rigid, oval leaves, peculiar to the moist low-country of Ceylon. It is of rather slow growth, but usually attains a height of 60–70 ft. or more, sometimes with an enormous trunk. Prop. by seed. (See *Trop. Fruits.*)

Axinandra zeylanica. *Lythraceae.* Kekiri-wara, *S.*—An ornamental tree, 40–50 ft. high, with handsome foliage and a straight trunk, bearing numerous slender, drooping branches almost to the base; lanceolate lvs., 7–10 in. long. Peculiar to the moist low-country forests of Ceylon.

Barringtonia speciosa. *Myrtaceae.* Mudilla, *S.*—A medium-sized handsome spreading tree, with large leathery shiny leaves, producing large white, fugacious flowers, consisting chiefly of a bunch of numerous, long white stamens. The large, quadrangular, one-seeded fruit, with its thick fibrous covering, is a good example of floating fruits, being commonly found in lagoons, rivers, etc. The tree is indigenous to the sea-coast of Ceylon, and is often planted for ornament. (See *Trees for Sea-coast.*)

Bertholletia excelsa. Brazil Nut. (See *Trop. Fruits.*)

Brassaia actinophylla. A handsome evergreen tree, 30–40 ft. high, with very large radially-divided leaves. (See *Flowering Trees.*)

Caesalpinia coriaria. Divi-divi. (See *Tans*, etc.)

Canarium commune. Java Almond. (See *Trop. Fruits.*)

Carapa guianensis. *Meliaceae.* Carapa or Andiroba Tree. A quick-growing tree, 60–80 ft. high, with handsome pinnate leaves, composed of 8–10 pairs of leaflets,

native of Trop. America. Thrives at Peradeniya and is suited to the moist low-country. (See *Fixed Oils.*)

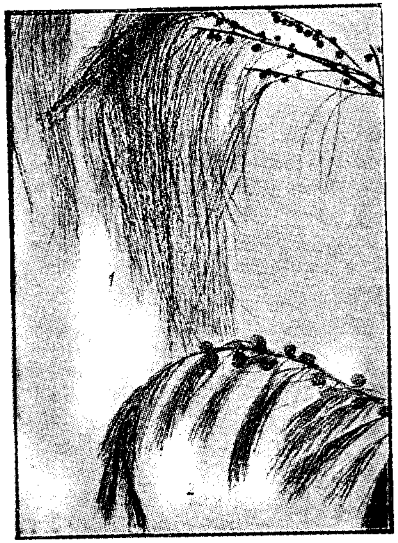
Casuarina equisetifolia. *Casuarineae.* She-Oak; Beef-wood; Kana- or Kana-gaha, *S*; Chavaku, *T*. A lofty, quick-growing tree, with fine filiform branchlets 6–8 in. long, instead of leaves, native of N. Australia. It is specially adapted to the sea-coast and dry regions, but thrives also inland up to about 3,000 ft. For fuel, the tree may be cut down when 10 or 12 years old. It has been largely planted in S. India and Mauritius for fuel and for reclaiming sandy sea-shores, becoming in both cases quite naturalised. It is of ornamental character when young, and is grown in temperate countries as a hot-house plant for decorative purposes. Prop. by the small seed, of which some 20,000 go to an ounce. (See *Trees for Fuel* and *Sea-coast.*)

Barringtonia speciosa.
Showing (1) flowers, (2) fruit whole and (3) in section.

Chrysophyllum Cainito. Star-apple. (See *Trop. Fruits.*)

Copaifera officinalis. *Caesalpinieae.* Balsam Copaiba. A wide, spreading or upright tree, with small, unequally pinnate leaves, distinguished by the yellowish-grey, smooth bark; native of Cent. America, etc. Introduced to Ceylon in 1880. (See *Gums and Resins.*)

Couratari pyriforme. *Lecythidaceae.*—A large, upright tree with spreading branches and small, oval, serrate leaves, native of Trop. America, introduced at Peradeniya in 1888. Deciduous for a short period in October or November.



(1) *Casuarina montana.*
(2) *C. equisetifolia.*

Cyathocalyx zeylanicus. *Anonaceae.* Kekala or Ipetta, *S*.—A tall, quick-growing tree, with a straight erect stem, long slender graceful branches, and leaves 6–10 in. long, native of the moist low-country of Ceylon. Bears ovoid yellow, edible fruit, $2\frac{1}{2}$–3 in. long.

Dillenia indica. *Dilleniaceae.* Hondapara or Wampara, *S*.—A handsome, moderate-sized, round-headed, symmetrical tree, native of Ceylon, India and Malaya; characterised by large, oblong, glabrous, serrate leaves, which are 10–12 in. long. Flowers large, pure white, 6–7 in. in diameter. (See *Trop. Fruits.*)

Dimorphandra Mora. *Leguminosae.* Mora Tree of British Guiana. A lofty handsome tree with pinnate leaves, noted for its excellent timber. The large pods, produced in November–December, each contain only one seed, which is remarkable for its immense embryo. Introduced to Ceylon in 1881.

Duabanga moluccana. *Lythraceae.*—A very handsome tree, attaining 80–90 ft. in height, with very long, graceful, drooping, slender and brittle angular branchlets, bearing long, distichous, shiny leaves; native of the Moluccas, introduced in 1852 at Peradeniya, where it forms a striking object.

Durio zibethinus. Durian. A noble tree of symmetrical habit, attaining a height of 80–100 ft. or more. (See *Trop. Fruits.*)

Enterolobium cyclocarpum. *Leguminosae.* Mulatto's Ear.—A tall, erect, handsome tree with fine feathery foliage, native of Venezuela, introduced to Ceylon in 1884. Bears in the dry weather, when it is deciduous, curious and almost circular, flat contorted pods, 5 in. diam.

Erythrina Parcelli. *Leguminosae.* A small, soft-wooded, quick-growing tree with ornamental variegated foliage, the leaves being marked by creamy-yellow bands running along the main veins. Native of South Sea Islands. Prop. by cuttings.

Eucalyptus alba. *Myrtaceae.* White Gum. A lofty tree with smooth, white bark and slender drooping branches; native of N. Australia, introduced to Ceylon in 1884. One of the few Eucalypti adapted to low elevations in the tropics; thrives in semi-dry regions, fruiting freely at Anuradhapura, Ceylon.

Rambong or India-rubber Tree (*Ficus elastica*).
Showing buttressed roots, in Royal Botanic Gardens, Ceylon.

Fagraea fragrans. *Loganiaceae.* Tembusu. A symmetrical upright, evergreen, small-leaved tree of Malaya, where it is grown for ornament and in avenues, etc. Introduced at Peradeniya in 1891. (See *Avenue Trees.*)

Ficus benghalensis. *Urticaceae.* Banyan. A large, spreading, smooth-barked tree with large, leathery, shiny leaves; very effective when bearing its crop of large, bright crimson berries, usually in August–September. Remarkable for its aerial roots, which hang from the branches and on reaching the ground rapidly take root and develop into independent stems supporting one immense head, resembling a number of trees. Many species begin life as an epiphyte. (See fig. on p. 42.)

F. Benjamina. Java Fig or Java Willow.—A large, handsome spreading tree, with small ovate leaves and long, graceful, slender branches, indigenous to Malaya; introduced at Peradeniya in 1861. Used in Egypt as an avenue and street tree.

F. comosa. Considered a variety of the preceding species, which it resembles in general habit, but has larger leaves. Fruits bright yellow.

F. Cunninghamii. Queensland Fig. A large graceful spreading tree, with long, drooping branches and small oval leaves; very effective for lawns or parks. Similar to *F. Benjamina.*

F. elastica. Rambong, or India-rubber Tree.—A very large, handsome, spreading, quick-growing tree, attaining a height of well over 100 ft., with large, oval, leathery, shiny leaves, native of Assam, Burma and

Malaya; introduced to Ceylon about 1835. A very remarkable tree at Peradeniya on account of its enormous aerial buttressed roots. The leaves of young shoots are much larger than the ordinary leaves, suggesting a different tree. Prop. by cuttings. (See *Rubber*.)

F. regia.—A lofty, erect tree, with straight stem, smooth, white bark and large oval leaves, bearing a profusion of large fig-like fruits on the trunk and older branches; native of Burma, Malaya, etc.

Filicium decipiens. *Burseraceae.* Pehimbiya, *S.*—A medium-sized or large tree, of rather slow growth, with very handsome fern-like foliage, as the botanical name implies; native of Ceylon and S. India. Produces in March–April quantities of soft fleshy seed, which are of short vitality. Sometimes cultivated as an ornamental pot-plant.

FERN-LEAF TREE (*Filicium decipiens*). Leaves show remarkable resemblance to a fern.

Kigelia pinnata. *Bignoniaceae.* Sausage Tree. A moderate-sized, spreading tree of Trop. W. Africa, bearing large pinnate leaves and long racemes of dull purplish bell-shaped flowers. Its remarkable oblong, grey gourd-like fruits are suspended by long cord-like stalks from 3–5 ft. in length. Each fruit is about 8–14 in. long by 3–4 in. thick. In Cent. Africa the tree is held sacred by the natives, and the fruit is used in medicine but not eaten.

Magnolia sphenocarpa (= **M. speciosa**). *Magnoliaceae.* Evergreen Magnolia. A moderate-sized or small, spreading tree, with large shiny, tapering leaves, 8–16 in. long; native of the E. Himalayas. Thrives at medium elevations in Ceylon, having been long established at Peradeniya.

SAUSAGE TREE (*Kigelia pinnata*). Remarkable for its gourd-like fruits.

Melia dubia. *Meliaceae.* Lunu-midella, *S*; Malaivempu, *T.* A very large, handsome tree of rapid growth, with small bipinnate leaves and smooth bark; native of Ceylon, India, Africa, Australia, etc. Wood light, soft, brownish-red, with large pores, much used for ceilings, etc. Fruit a drupe, with a horny kernel, containing 2–4 small seeds. (See *Timber and Fuel Trees*.)

Mesua ferrea. Ceylon Ironwood; Mesua.—

A handsome, shapely, closely branched evergreen tree, with small lanceolate leaves. The bright crimson young foliage, which appears twice a year, chiefly in November and April, renders the tree a particularly handsome and conspicuous object. (See *Flowering Trees*, also *Timber and Windbreaks*, etc.)

Myroxylon Balsamum. *Leguminosae.* Balsam Tree. A large handsome tree of Trop. America, with small pinnate, dark-green leaves. Good for roadsides, fuel and timber. Thrives in moist as well as in rather dry districts. The fruit, consisting of a lance-shaped, one-seeded pod, is produced usually in June and December. Introduced to Ceylon in 1870.

M. toluiferum, a similar tree of Trop. America, etc., introduced to Ceylon in 1861. Like the former, it yields a fragrant gum-resin known as Balsam-of-Tolu, obtained by tapping and used in medicine, etc. (See *Gums and Resins*.)

Pandanus furcatus. *Pandanaceae.* Screw-pine. A large, handsome species, native of India, 30–40 ft. high, with long, prickly leaves arranged in screw-like form. Hence the common name.

P. Leram. Nicobar Islands Bread-fruit. A striking species of Screw-pine with the stem repeatedly forked, bearing immense, round, green fruits, said to be edible; introduced at Peradeniya in 1883. The tree is also remarkable for its large aerial roots, which give it the appearance of being on stilts.

Pangium edule. *Bixaceae.* Kapayang or Pangi (Malay). A quick-growing, spreading tree with large heart-shaped leaves, bearing large, ovoid reddish-brown fruits, about 6 in. long; native of Malaya, introduced to Ceylon in 1891. Fruit and seeds edible, but the latter contain hydrocyanic acid, which, however, can be removed by cooking, when they are rendered edible. Seeds yield a useful oil.

SCREW PINE (*Pandanus furcatus*). Showing corkscrew arrangement of foliage.

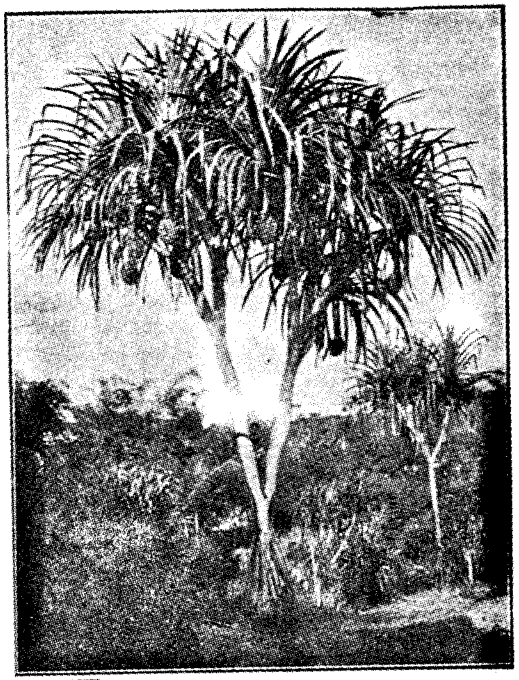
Parkia Roxburghii. *Leguminosae.* A remarkably handsome, quick-growing, lofty tree, attaining a height of 120 ft. or more, with a clear smooth trunk and beautiful, fine feathery, large, pinnate leaves; indigenous to Malaya, Burma, etc. Thrives in the moist low-country up to about 2,000 ft.; flowers in dense knobs suspended by long stalks, produced in Nov.–December, followed in Feb.–March by large, hanging clusters of long, brown pods, which contain a quantity of white powdery substance, which is edible (See fig. on p. 98.)

Parmentiera cerifera. *Bignoniaceae.* Candle Tree; Pandam-gaha, *S.* A small tree of Trop. America, with small, light-green, twice-trifoliate leaves. It bears remarkable, cylindrical, fleshy, candle-like yellow fruits along the stem and branches, in great profusion twice a year, chiefly during the drier months. These are 15–20 in. long, resembling the old-

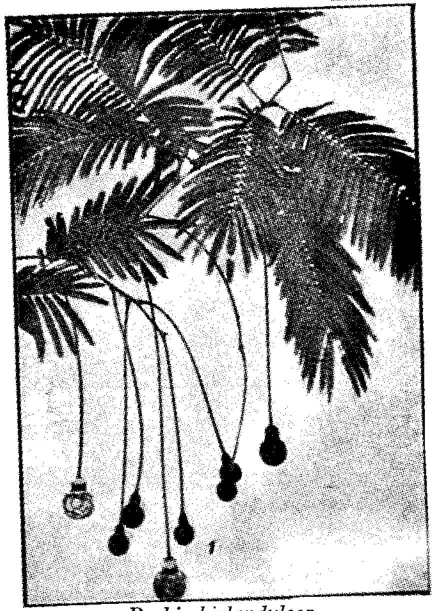
fashioned candles of shops, but are of no practical use. They are said to be eaten in the tree's native home. (See fig. on p. 99.)

Pisonia alba. *Nyctagineae.* Lettuce Tree; Lady-love; Watabanga-kola, *S*; Lechchai-kottai or Chandi, *T*.—A small, evergreen tree, 25–30 ft. high, with striking pale-yellow foliage, specially adapted to the sea-coast. Readily prop. by cuttings. Leaves sometimes used in Ceylon as a vegetable, also in native medicine, and cattle are fond of them.

Pithecolobium (Enterolobium) Saman. *Leguminosae.* Rain-tree; Guango; Inga Saman, or Saman Tree; Peni-karal, *S*. A very large, spreading, quick-growing tree, commonly planted in Ceylon and other tropical countries as shade

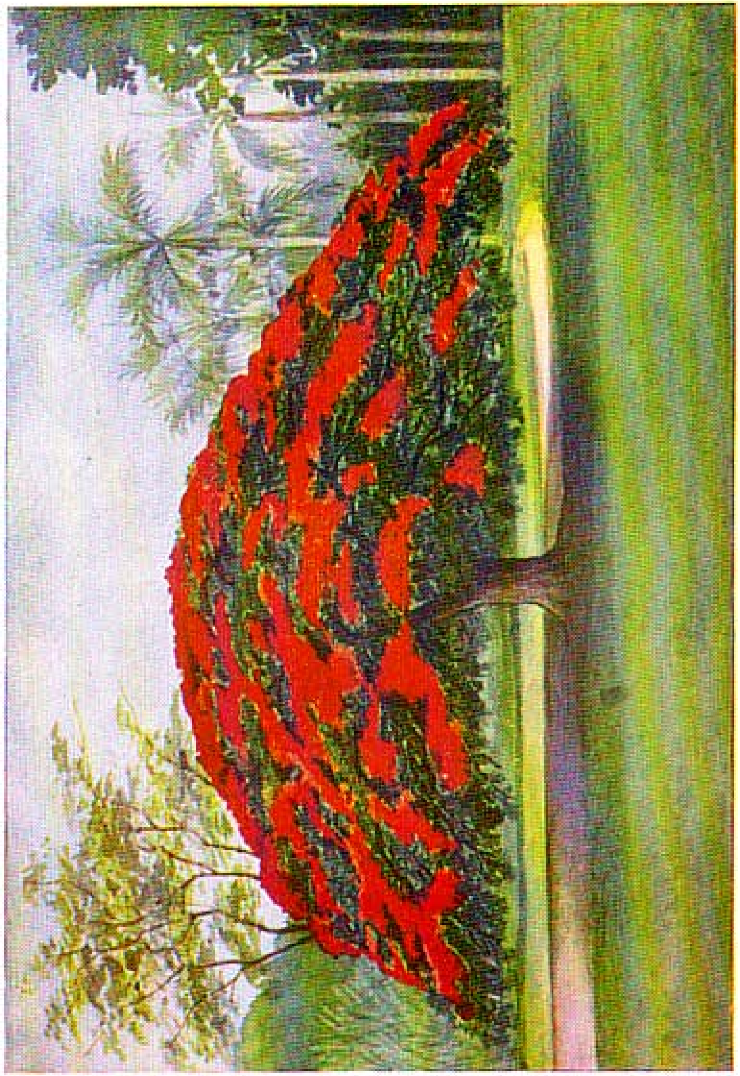


Nicobar Bread-fruit (*Pandanus Leram*).



Parkia biglandulosa.
Showing fl's. and handsome foliage.

for roads, for which it is well suited until it becomes too large. It has rather a shallow root-system, grows rapidly and attains an enormous size in hot, moist districts, becoming top-heavy and losing its upright symmetrical habit. In drier districts, however, it does not grow to such large proportions and makes an excellent shade tree for roads. First introduced from Trop. America into Ceylon about 1850. The brown, rather flat pods, produced chiefly from March to May, are about 6–8 in. long and, like the Carob-beans, contain a quantity of sweet sugary pulp and are relished by cattle. They are exported from S. America for cattle-food. The small pinnate leaves, which form a canopy of shade in the day-time, close up at night, so that during a period of drought a patch of green grass may be seen beneath, while the surrounding ground is parched and brown. This led to the supposition that the tree mysteriously produced rain at night; hence the name Rain-tree. (See *Roadside Trees.*)



POINCIANA REGIA, Boj.
FLAMBOYANTE or GULI-MOHUR.

Piptadenia peregrina. *Leguminosae.* Yoke; Cohoba. A tall, elegant tree of Trop. America and W. Indies, with fine feathery fern-like foliage, consisting of pinnate linear leaves. Flowers white. Pod about 10 in. long, containing about 12 brown seeds, which when finely ground form Cohoba- or Coxoba-snuff. The latter when inhaled, it is said, causes a sensation like drunkenness. Wood heavy and hard.

Podocarpus cupressinus. *Coniferae.* Kawtabua of Fiji. A large, elegant, erect tree, with small bipinnate leaves; very ornamental, especially in the young state; native of Java, Fiji, etc. Introduced at Peradeniya in 1880, and occasionally produces a few seeds here. Bears pollarding well; said to attain 150 ft. or more in height and affords good timber. **P. gracilior** and other species found in Trop. E. Africa are noted for their great height and excellent timber.

Poinciana regia. Flamboyante. Handsome foliage. (See *Flowering Trees.*)

Pometia eximia. *Sapindaceae.* Gal-mora or Bulu-mora, *S.*—A handsome tree, 80–100 ft. high, with a straight, erect trunk and large spreading head, native of the moist low-country of Ceylon, up to about 1,500 ft.; also indigenous to Malaya. Fruits in clusters of ovoid berries, crimson when ripe, chiefly in July–August.

Pterocarpus indicus. *Leguminosae.* Padouk. — A handsome, lofty tree of Andaman Islands, with a spreading round head, long drooping branches, and rather small pinnate leaves; bears a profusion of yellowish, scented flowers in March or April, followed by small, circular, winged pods. Famous for its fine timber.

CANDLE TREE (*Parmentiera cerifera*).
Creamy-white fruit resemble candles.

Pterospermum acerifolium. *Sterculiaceae.* A tall tree of Burma, with large, oval, leathery leaves, creamy-white or grey underneath, with prominent veins; long, fleshy, yellowish, scented flowers. Introduced to Ceylon in 1852.

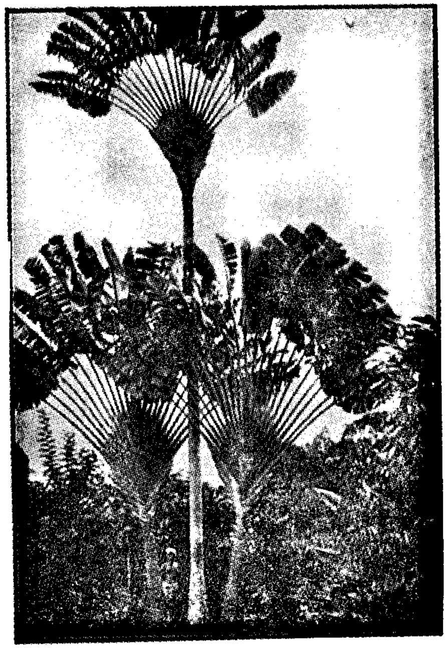
Ravenala madagascariensis. *Scitamineae.* Travellers' Tree. A remarkable-looking tree (or large bush) of Madagascar, introduced to Ceylon before 1824. It requires a hot, humid climate, and attains a height of 30–40 ft., assuming the form of a gigantic fan. The immense distichous leaves are 12–15 ft. in length, the older of which, like those of the Banana tree of the same family, are invariably torn into ribbons by the wind; but this does not detract from their ornamental character. The large, hollow, sheathing leaf-stalks form receptacles in which considerable

quantities of secreted water are stored, hence the popular name. Prop. by suckers or seed. The latter is surrounded by a bright blue aril.

Sandoricum indicum. Santol (Malay). A tall, erect, quick-growing tree, with pinnate leaves, native of Malaya, introduced to Ceylon in 1852. (See *Trop. Fruits.*)

Schizolobium excelsum. A large, quick-growing tree, with spreading branches and very long, graceful, feathery bipinnate leaves. (See *Flowering Trees.*)

Swietenia Mahagoni. *Meliaceae.* Mahogany; Rata-kohomba, *S.* The mahogany tree, long noted for its superior wood, is a native of Trop. America and was introduced to Ceylon about 1840. It is a useful shade and ornamental foliage tree, being evergreen, upright, 60–70 ft. high, with small pinnate lvs.; best suited to a rather dry climate, *e.g.* north of Ceylon, where it seeds freely during June–July. About 1,900 of the brown corky seeds = 1 lb. Flourishes in various parts of India, is rather a slow-grower, but makes a fine, shapely, durable tree. (See *Shade Trees.*)



TRAVELLERS' TREE (*Ravenala madagascariensis*).
Remarkable fan-shaped tree.

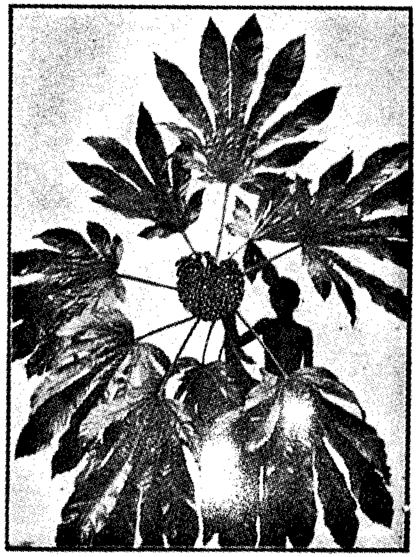
S. macrophylla. Large-leaved Mahogany. A handsome, upright tree, also of Trop. America, distinguished from the former by its larger leaves; it is a more rapid grower, and thrives in dry or moist climate up to about 2,000 ft. This is now considered to be the source of Honduras and Mexican mahogany, the former furnishing Cuban mahogany. The timber weighs 35·6 lb. per cubic foot. The determination of this species and its introduction to the East were due to chance seeds being received with others and sown at the Roy. Botanic Gardens, Calcutta; the seedlings on reaching maturity were found to be a new species, which was afterwards named by King.

Terminalia belerica. *Combretaceae.* Myrobalan-tree; Bulu, *S*; Ranimaram or Tanti, *T.* A tall, stately tree, deciduous in dry season, with straight, often buttressed, trunk and long horizontal branches, native of the moist low country of Ceylon, India and Malaya; sometimes planted in India as a roadside tree. (See *Tans.*)

T. Catappa. Country- or Indian-Almond; Kotamba, *S.* A medium-sized or large tree, with large ornamental, glossy leaves, native of Malaya, but grown in most trop. countries. It has the disadvantage of shedding its leaves twice a year, usually in February and September, causing a considerable litter on the ground. Before dropping the leaves, however, it is a striking object, the mature leaves becoming bright red to yellow. (See *Trop. Fruits.*)

T. Arjuna. Arjan. A handsome tree of Cent. India, where it is often used for roadsides.

Trevesia moluccana. *Araliaceae.* A small, sparsely branched tree, with very large, spreading palmate leaves, native of Moluccas. Fruit produced in large round clusters of berries, dark purple when ripe. Introduced at Peradeniya, Ceylon, in 1871.



Trevesia moluccana.
Handsome foliage tree.

Trichadenia zeylanica. *Bixaceae.* Tolol or Titta-tolol, *S.* A large tree with handsome foliage, the oblong or oval leaves being 6–12 in. long, borne on long slender branches. Moist low-country.

Vateria acuminata. *Dipterocarpeae.* Hal, *S.* A large, handsome, upright tree, with spreading branches and a round head. Leaves leathery and oblong, 8–10 in. long. Fruit large, pear-shaped and fleshy. Peculiar to the moist low-country of Ceylon. Prop. by the large one-seeded fruits, sown entire. Bark commonly used for retarding fermentation in palm toddy. (See *Gums and Resins,* also *Tans.*)

CHAPTER XII

SELECTED ORNAMENTAL PLANTS

SUITED TO LOW AND MEDIUM ELEVATIONS

See also Chapters XV to XVII (pp. 169–207).

1. *FLOWERING SHRUBS.*
2. *FOLIAGE SHRUBS.*
3. *FLOWERING CLIMBERS.*
4. *FOLIAGE CLIMBERS.*
5. *ORNAMENTAL CREEPERS.*
6. *LIANES OR GIANT CLIMBERS.*
7. *SHOWY ANNUALS AND PERENNIALS.*
8. *BULBOUS OR TUBEROUS PLANTS.*
9. *SELECTED ORNAMENTAL PLANTS INDIGENOUS TO CEYLON.*

Letters in brackets = usual method of propagation, thus (C.) = Cuttings; (S.) = Seeds; (Div.) = Division; (Off.) = Offsets; (Tu.) = Tubers; (Lay.) = Layers; (Rhiz.) = Rhizomes; (Su.) = Suckers. Fl's. = Flowers; Lvs. or L. = leaves. Sh. = Shrub; Cl. = Climber; Var's. = Varieties. *Colour* refers to flowers. *Figures* indicate approximate height in feet.

FLOWERING SHRUBS

Acalypha sanderiana. *Euphorbiaceae.* New Guinea. 5–6. Bright crimson, in pendulous tails or catkins. (C.)

Acalypha sanderiana.
Flowers in long crimson tails.

Acanthus montanus. *Acanthaceae.* Rose-pink. 5–6. L. large, spiny. **A. pubescens.** Fl's. pink, similar to preceding species. **A. ilicifolius.** Ikili or Katu-ikili, *S.* 3–4. Fl's. bright pale pink. L. 4–6 in. long, spiny. In sea-coast swamps. (C. or S.)

Acokanthera spectabilis. Arrow-poison. *Apocynaceae.* Trop. Africa. White, scented. 6–8. (C.) See *Poisons.*

Adhatoda cydoniaefolia. *Acanthaceae.* Brazil. White and purple. 5–6. (S. or C.)

Allamanda Schottii. *Apocynaceae.* Brazil. Yellow. 3–4. (S. or C.) **A. violacea.** Brazil. Rosy-purple. 5–7. (C.)

Alstonia sericea. *Apocynaceae.* Java. White. 3–4. (S. or C.)

Amomum magnificum. See *Fol. Shrubs.*

Aphelandra fascinator. *Acanthaceae.* Colombia. Scarlet. **A. tetragona.** Fl's. in scarlet, erect heads. 6–8. (S. or C.)

Ardisia crenata. *Myrsineae.* China. Creamy-white. 2–4. Showy crimson berries. (S.)

Aristolochia tricaudata. *Aristolochiaceae.* Mexico. 4–5. Fl's. purplish-brown, elongated into 3 pointed lobes. (C.)

Asclepias curassavica. *Asclepiadeae.* W. Indies. Orange-red. 4. (S.)

Asystasia chelonioides. *Acanthaceae.* Ceylon and S. India. Reddish-purple. 4–6. (S. or C.) Several other species, with yellow, white, or mauve fl's.

Baccharis rhexioides. *Compositae.* S. Amer. White. 4. L. 3-nerved. (S. or C.)

Barleria cristata alba. *Acanthaceae.* India, Malaya, etc. White. **B. cristata rosea.** Pink, mauve, or rose. See *Hedges.* **B. Gibsoni.** India. Purple. **B. strigosa.** Pale blue. 3–5. (C. or S.)

Bauhinia candida. *Leguminosae.* India, etc. Pure white. **B. Galpini.** S. Africa. Brick-red, very showy. 5–6. (S. or C.)

Beloperone nemerosa. *Acanthaceae.* Jamaica. Pink. **B. oblongata.** Brazil. Rose-pink. 4–5. (C. or S.)

Bougainvillea formosa. Straggling sh. or cl. with long, arching, floriferous, spiny branches. Fl's. bright purple, chiefly in dry season. Sun-loving. (C.) See *Flowering Climbers.*

Clerodendron nutans.

Brunfelsia americana. *Solanaceae.* Trop. Amer. White or pale yellow, long tubular fl's., scented like Jasmine. 5–7. (C. or S.) **B. calycina.** Brazil. Large purple fl's. 3–5 (= **B. lindeniana**). **B. hopeana** (= **B. uniflora** and

Peacock Flower (*Caesalpinia pulcherrima*).

Capparis zeylanica.
White flowers with crimson centre.

Franciscea bicolor). Brazil. Purplish-blue and white in separate fl's., the blue becoming white; sweet-scented. 4–6. (C. or S.) Beautiful sh., flowering profusely, slow-growing. **B. violacea.** W. Indies. Deep purple. 4–5.

Byrsonima ligustrifolia. *Malpighiaceae.* S. Amer. Orange-red. 8–12. (S.)

Caesalpinia pulcherrima. Peacock Flower; Barbados' Pride. *Leguminosae.* W. Indies. Orange-red or yellow; long stamens, showy. 6–8. (S. or C.)

Calliandra haematocephala. *Caesalpinieae.* Pinnate lvs. Fl's. crimson, in round brush-like heads. **C. Tweedii.** Brazil. Floriferous, bright pink; 5–6; fine foliage. (S. or C.)

Callicarpa Reevesii. *Verbenaceae.* Large straggling sh. or small tree. L. large, tomentose. Fl's. pink, in large cymes. S. China.

Capparis zeylanica. *Capparideae.* Ceylon. White and red; spiny. 6–7. (S.)

Cassia alata. *Leguminosae.* Tropics. Yellow and orange, upright spikes. 5–6. **C. auriculata.** Ranawara, *S*; Matara Tea. Ceylon and India. Yellow. 6–8. See *Drugs*, also *Tans*. **C. corymbosa.** S. Amer. Yellow and orange. 4–5. (S.)

(1) *Cestrum aurantiacum.* Fl's. yellow.
(2) *C. nocturnum.* Queen-of-the-Night.

Cestrum aurantiacum. *Solanaceae.* Guatemala. Orange-yellow. **C. elegans.** Purplish-red fl's. and berries. 5–7. **C. nocturnum.** Queen-of-the-Night; Hassu-na-Hana. Fl's. greenish-white, strongly scented at night. Large straggling sh. 5–8. Peru. (C.)

Chiococca racemosa. *Rubiaceae.* W. Indies. White, turning to cream. 5–6. (S. or C.)

Clavija ornata. *Myrsineae.* S. Amer. Small palm-like tree or sh. 8–15. Fl's. borne on stem. (S.)

Clerodendron fragrans. *Verbenaceae.* Java. 3–4. Fl's. white, shaded crimson, double, in squat heads, strongly scented. L. large, cordate. Nat. in Ceylon. **C. inerme.** Ceylon and India. White, tipped with red. 3–5. **C. infortunatum.** Ceylon, India, Malaya, etc. White, scented. 5–8. (C.) **C. macrosiphon.** Zanzibar. 3–4; long, delicate, tubular white fl's., with long pink stamens. (C.) **C. Minahassae.** Celebes. Spreading sh. White, free-flowering. 6–8. (C. or S.) **C. nutans.** Assam, etc. Greenish-white, long, drooping racemes. 5–6. (C. or S.) **C. odoratum (Caryopteris wallichianum).** White, suffused with purple. (C.) **C. paniculatum.** Pagoda-flower. Java. 5–6. Large, erect, scarlet panicles. L. large, angular. Very showy. (C.) See p. 105. **C. serratum.** Kenhenda, *S.* 5–7. Large, bright blue fl's. (C.) **C. siphonanthus.** India. Nat. in Ceylon. 6–8. Fl's. long, white, in large heads on long erect shoots; lvs. long, narrow, in whorls of 4. **C. squamatum.** India and China. 6–8. Scarlet. (C.) L. large, almost round. Nat. in Ceylon.

Clitoria cajanaefolia. *Leguminosae.* Malaya and Trop. Amer. Pink. 4–5. (C.)

Costus speciosus. *Scitamineae.* Ceylon, India, etc. White, yellow centre. 6–8. (S.)

Crossandra undulaefolia. *Acanthaceae.* Ceylon, India, etc. Orange-red or salmon-yellow; fl's. in dry season. Showy. 2–3. (S. or C.) See *Ceylon Plants*.

Crotalaria laburnifolia. Yakberiya, *S.* *Leguminosae.* Pale yellow. 2–4. (S.)

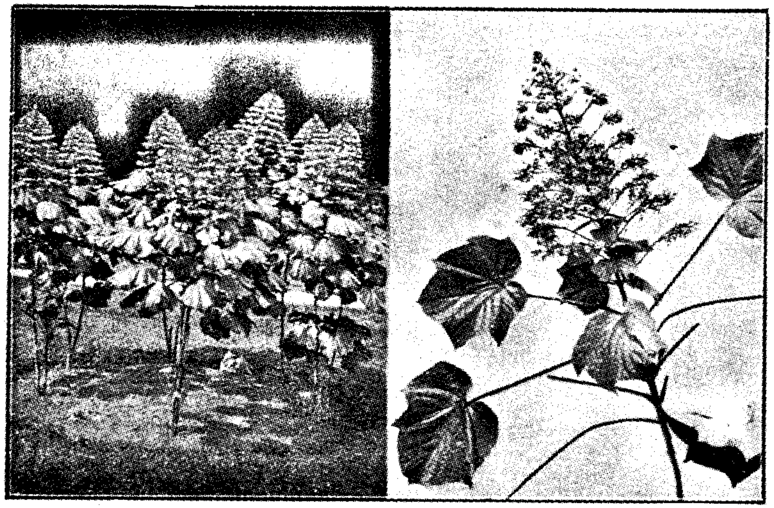
Cystacanthus turgidus. *Acanthaceae.* Cochin China. Spotted purple. 5–6. (C. or S.)

Daedalacanthus nervosus. *Acanthaceae.* India. Deep blue. 4–5. (C.)

Datura chlorantha. *Solanaceae.* Fl's. large, yellow, double. 6–8. (C. or S.) **D. fastuosa.** Attana, *S.* Ceylon, India, etc. Purple and white var's.; fl's. erect. L. large, angular. 2–3. (C. or S.) **D. (Brugmansia) suaveolens.** Trumpet

Clerodendron fragrans.

Clerodendron Minahassae.



Pagoda Flower (*Clerodendron paniculatum*).

Flower; Rata-attana, *S.* Mexico. Large, trumpet-shaped, pendulous, white fl's., 8–10 in. long, scented; ornamental and floriferous, 10–15. (C. or S.) Nat. in Ceylon.

Dombeya angulata. *Sterculiaceae.* Madagascar. Rose, pink and salmon shades.

8–10. Showy. (C. or S.) **D. Mastersii.** Trop. Africa. Creamy white. 5–6. **D. natalensis.** S. Africa. White or cream. 4–5. (C.)

Duranta Plumieri. *Verbenaceae.* S. Amer. Large sh. or small tree. Purplish-blue or white. 8–15. (C. or S.) Also a white-fl'd. var.

Ecbolium linneanum. *Acanthaceae.* Ceylon, S. India, etc. Pale blue. 4–5. (C. or S.)

Eranthemum cinnabarinum. *Acanthaceae.* Burma. Terracotta. 5. **E. pulchellum** (= **Daedalacanthus nervosus**). 4–5. (C.)

Erythrochiton brasiliensis. *Rutaceae.* Brazil. Bright red. 5. (S.)

Euphorbia Bojeri. *Euphorbiaceae.* Madagascar. Stems prickly, bronze or purple; fl's. bright coral red. (C.) **E. pulcherrima.** Poinsettia. Mexico. Bright scarlet, large bracts. 6–10. Also "double" and white var's. Very showy. (C.) **E. heterophylla.** S. Amer. 2–3; bracts small, green, pink at base. (C.)

Franciscea bicolor. See **Brunfelsia hopeana.**

Galphimia glauca. *Malpighiaceae.* Mexico. Bright yellow. 4–5. (S.)

Dombeya angulata. Flowers rose-pink.

Gardenia florida. "Cape Jasmine." *Rubiaceae.* China and Japan. Pure white. Highly fragrant, semi-double. 4–6. (C.)

Goethia strictiflora. *Malvaceae.* Brazil. Fl's. orange-red, borne along the stems; the latter few and unbranching. 6–7. (C.)

Goldfussia rubescens. *Acanthaceae.* Blue fl's. 3–4. (C.)

Gomphia decora. *Ochnaceae.* Brazil. Bright yellow. 4–5. (S. or C.)

Gomphocarpus fruticosa. Balloon Plant. *Asclepiadeae.* S. Africa. 4–5. White. Large, peculiar, balloon-like fruits with long fleshy hairs. (S.)

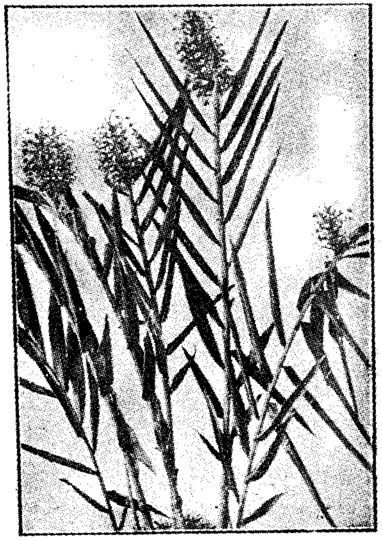
Hamelia patens. *Rubiaceae.* S. Amer. and W. Indies. Orange-red. 5–8. (C.)

Hedychium angustifolium. *Scitamineae.* Ceylon, Assam, etc. Bright red, large heads. 5–6. (Div.)

Heeria macrostachya. *Melastomaceae.* Mexico. White, loose sprays; square stems. 4–5. L. opposite. (C.)

Helicteres isora. Liniya, *S.* *Tiliaceae.* Ceylon, India, etc. Brick-red. 5–6. (C.)

Hibiscus mutabilis. "Chinese Rose." *Malvaceae.* China. Fl's. large but sparse. Single and double var's., white and pink. 5–7. (C.). **H. rosa-sinensis.** Shoe-flower; Sapathu-mal, *S.* Numerous var's. or crosses; large, single or double fl's. of different shades, many very showy. 6–12 or more. Prop. by cuttings. Among the best are: *Double*: "Aurora," large, scarlet; "Salmo," large salmon-pink; "Avoca," pale yellow; "Stella," small fl's., salmon-red, slow-growing; "Eureka," dwarf, pure white, carnation-like; "Variegata," scarlet, streaked



Hedychium angustifolium.
Flowers bright red.

Holmskioldia sanguinea.
Parasol Flower.

with white. *Single*: "Venus," large brilliant crimson with dark-brown rays radiating from centre, lvs. deeply cut; "Aphrodite," large bright pink; "Argosy," rich salmon; "Etna," bright salmon-pink; "Albus," creamy-white with dark centre; "Aurea," pure yellow; "Ophir," bright sulphur-yellow; "Rosaschizo," scarlet, a cross partaking of the characters of Rosa-sinensis and Schizopetalus; "Delta," brilliant scarlet, broad petals; "Cooperi," variegated coppery-green foliage. **H. schizopetalus.** Trop. Africa. Long, drooping, orange-red or variegated fl's., petals fringed and recurved; slender, arching branches. 6–8. (C.) **H. syriacus.** "Rose of Sharon." Erect sh.; bluish-purple fl's.; best suited to high elevations or sub-tropics. Several var's., different shades. **H. trionium** and **H. africana.** See *Annuals*, etc.

Holmskioldia sanguinea. Parasol-flower. *Verbenaceae.* N. India. Orange-red. 6–8. (C. or S.)

Humboldtia laurifolia. Gal-karanda, *S.* *Leguminosae.* Ceylon. Large sh. 8–12. White and pink fl's., scented. Hollow internodes. (S.)

Ixora coccinea. *Rubiaceae.* Ceylon, India, etc. Evergreen sh. Fl's. scarlet. **I. Fraseri.** Hort. Salmon-red. 4–5. **I. javanica.** Java. Orange. 5–6. **I. lutea.** Bright orange-yellow. 2–3. **I. macrothyrsa** (= **I. Duffii**). Sumatra. 4–5. Fl's. deep-red, in large clusters, very showy. (C. or layers.) **I. odorata.** Madagascar. Fl's. long, tubular, in large heads, white and pink. 6–8. **I. rosea.** Khasia. 4–5. Rose-coloured. (C.)

Jacobinia coccinea. *Acanthaceae.* Brazil. Scarlet or cerise. 5–6. (C. or S.) **J. aurantiaca.** Strong-growing. 5–8. Fl's. orange-yellow. **J. magnifica.** Brazil. Bright pink, large racemes. (C.)

Jacquinia ruscifolia. *Myrsineae.* Mexico and W. Indies. Bright orange. 6–10. (S.)

Jasminum Sambac. Pichcha, *S*; Malliapoo, *T.* India. Straggling semi-climbing sh.; fl's. pure white, strongly scented; lvs. glabrous. 5–6. (C.)

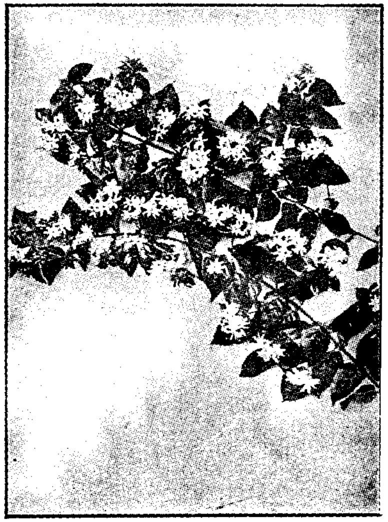
Jatropha multifida. *Euphorbiaceae.* 5–12. Fl's. scarlet. L. palmately cut. (C. or S.) **J. panduraefolia.** Cuba. 3–4. Fl's. rose-pink. L. fiddle-shaped. (C.) **J. podagrica.** Panama. 4–5. Orange-red. L. large, palmate-peltate. Tuberous stem. (C. or S.)

Jussieua suffruticosa. *Onagraceae.* Ceylon, etc. Yellow fl's. 2–3. (S.)

Justicia Betonica. Sudupuruk, *S.* *Acanthaceae.* Ceylon, etc. Greenish-white. 3–4. **J. calycotricha.** Brazil. Yellow. 2–3. (C. or S.)

Kopsia fruticosa. *Apocynaceae.* Burma, Java, etc. Pale pink. 6–8. (C. or S.)

Lagerstroemia indica. *Lythraceae.* Indian Lilac; Bonnet-flower; Crape Myrtle.



Jasminum Sambac.
Flowers scented, pure white.

INDIAN LILAC (*Lagerstroemia indica*). *Ixora odorata.* Long tubular flowers.

China and India. Large magenta sprays; white and pink var's. 6–8. (C. or S.)

Memecylon umbellatum.
Flowers deep blue, in clusters.

Lantana nivea. *Verbenaceae.* Trop. Amer. White; also pink and other var's. Used for hedges, etc. **L. trifolia.** Purple. L. in 3's. **L. aculeata.** Common Lantana. Scarlet. 4–6. (C. or S.) See *Weeds*.

Malvaviscus arboreus. *Malvaceae.* S. Amer. Small scarlet fl's. 4–6. (C. or S.)

Medinilla magnifica. *Melastomaceae.* Philippines. Rose-pink; large, pendulous sprays; lvs. large, 7- to 9-nerved. **M. speciosa.** Malaya. Crimson. 5–8. **M. Teysmanni.** Java. Creamy white. 5–6. (C.)

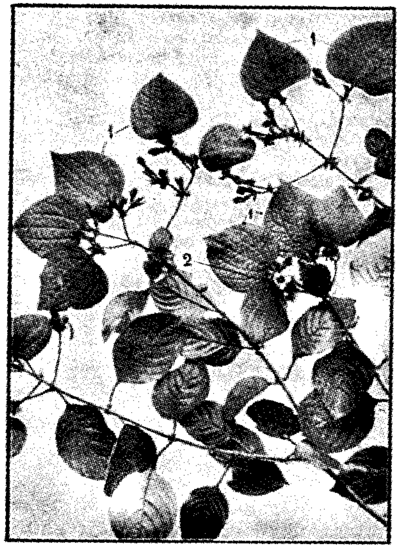
Melastoma malabathricum. Maha-bowitiya, *S. Melastomaceae.* Ceylon and India. Bright pink, large solitary fl's. 4–6. (C. or S.)

Memecylon umbellatum. Korakaha, *S. Melastomaceae.* Ceylon and S. India. 6–8. Fl's. small, deep blue, in crowded clusters along the stems, showy. (S.)

Montanoa bipinnatifida. Tree-daisy. *Compositae.* Mexico. 8–12. Large white loose sprays, in great profusion; Dec.–Jan. **M. tomentosa.** Mexico. 8–12. White fl's., yellow centre, smaller than those of above; lvs. tomentose. (C.)

Kopsia fruticosa.
Flowers pale pink.

Lantana nivea.



Mussaenda erythrophylla.
(1) Bright scarlet bracts.
(2) Small yellow flowers.

TREE DAISY (*Montanoa bipinnatifida*).
Flowers white, yellow centre.

Murraya exotica. Etteriya, *S.* *Rutaceae.* Eastern Tropics. Small tree or large sh. with white, scented fl's.; small pinnate lvs. (S.)

Mussaenda erythrophylla. *Rubiaceae.* Trop. Africa. Climber or scandent sh., can be trained as either. One of 5 sepals much enlarged, bright scarlet, very showy. Corolla yellow, small and inconspicuous. (C.) **M. frondosa.** Similar to above; enlarged sepal white. **M. luteola.** 2–3. Dwarf sp. Fl's. small, pale yellow; enlarged sepal yellowish-white. (C. or S.)

Myrtus communis. Myrtle. *Myrtaceae.* S. Europe. 6–8 or more. Whole plant fragrant. Small white fl's. (C. or S.) **M. tomentosus.** See *Rhodomyrtus.*

Nerium Oleander. Oleander. *Apocynaceae.* Asia Minor. Beautiful evergreen, free-flowering sh., specially suited to dry, sunny locality. Bears large clusters of bright pink fl's. Several " single " and " double " var's., white, bright red, crimson, etc. (S., C., or Su.) See p. 205, also *Poisons.*

OLEANDER (*Nerium Oleander*).
(1) Rose-pink var., (2) White var.

Notonia grandiflora. *Compositae.* India. Yellow. 5–6. (C. or S.)

Ochna Kirkii. *Ochnaceae.* E. Trop. Africa. Fl's. bright yellow, berries scarlet. 4–5. (C. or S.)

Osbeckia aspera. Bowitiya, *S.* *Melastomaceae.* Ceylon and India. Bright purplish-crimson. 4–5. (S.) **O. rubicunda.** See p. 135.

Oxyanthus natalensis. *Rubiaceae.* Natal. White, long, slender tubular fl's., in bunches. 4–5. Squat sh. (C.) **O. tubiflorus.** W. Trop. Africa. White, erect; large oval lvs. 5–7. (C.)

Palicourea gardenioides. Mexico. Creamy-white, in bunches. 5–6. (C.)

Paulwilhelmia speciosa. *Acanthaceae.* Abyssinia. Blue, showy. 4–5. (C.)

Pavetta indica. Pawatta, *S.* *Rubiaceae.* Ceylon and India. Long white fl's., in close clusters. **P. lanceolata.** S. Africa. White. 4–6. (C.)

Pentas carnea. *Rubiaceae.* Trop. Africa. Several var's., pink, mauve, white, etc.; fl's. in bunches. Very pretty; useful for cut fl's. 2–3. (C. or S.) See fig. on p. 129.

Peristrophe speciosa. *Acanthaceae.* Himalaya. Carmine purple. 4. (C.)

Phlogacanthus thyrsiflorus. *Acanthaceae.* India and Java. Purple. 4–6.

Phyllanthus pulcher. Malaya. **P. speciosus.** Jamaica. 3–5. Flat green phyllodes (*q.v.*), bearing small crimson fl's. along margins. (C. or S.) See *Fol. Shbs.*

Plumbago capensis. *Plumbaginaceae.* S. Africa. Pale blue. **P. rosea.** Ratnitul, *S.* India. Rose scarlet. 2–3. Medicinal. **P. zeylanica.** Ela-nitul, *S.* Ceylon, etc. White. 2–3. (C. or S.) See p. 371.

Poinsettia. See *Euphorbia pulcherrima.*

Portlandia grandiflora. *Rubiaceae.* W. Indies. White. Fl's. large, fragrant, trumpet-shaped, in pairs. 8–12. (C.)

Quassia amara. *Simarubaceae.* Guiana. Surinam Quassia. Scarlet. 6–8. (C. or S.)

Randia maculata. *Rubiaceae.* Trop. Africa. 6–10. Long, tubular fl's., brownish-white. **R. macrantha.** Trop. Africa. 5–8. Remarkable, long, drooping, tubular, white fl's. in great profusion. **R. Mussaenda.** S. Amer. Small, pure white, star-like fl's. 6–8. (C.)

Ravenia spectabilis. *Rutaceae.* S. Amer. Pink. 3–4. (C.)

Reinwardtia tetragyna and **R. trigyna.** *Lineae.* India. Both yellow. 3–4. (S. or C.)

Randia macrantha.
Long, tubular, pure white flowers.

Rhodomyrtus tomentosa. *Myrtaceae.* Ceylon. Fl's. comprise bunches of numerous, bright pink stamens. 6–10. (C.)

Rondeletia odorata. *Rubiaceae.* Mexico. Salmon-pink; slender branches. Fl's. orange-yellow. **R. speciosa.** Fl's. scarlet; erect, rigid branches. 4–5. (C.)

Rudgea macrophylla. *Rubiaceae.* Brazil. 4–5. Fl's. creamy-white, in large heads; leaves large, obovate. (C.)

Russelia juncea. *Scrophulariaceae.* Mexico. Scarlet. L. linear, verticillate, grass-like, pendulous. 3–5. **R. sarmentosa.** Leafy sh. 4–6. Fl's. pink. (C.)

Salvia coccinea. *Labiatae.* Cent. Amer. Scarlet. 2–3. **S. coelestina.** Mexico. Lilac-blue. 2. **S. farinacea.** Texas. Lavender-blue. 1½. Several var's. and shades, pale to deep purplish-blue, etc. **S. splendens.** Brazil. Bright scarlet, very showy. 3–4. (C.)

Sanchezia longiflora. *Acanthaceae.* S. Amer. Magenta. 6–8. (C.)

Solanum Rondelettii. *Solanaceae.* Deep purplish-blue, mottled. 5–6. (C. or S.)

Sophora violacea. *Leguminosae.* Ceylon. Violet-blue. 2–3. (S.)

Stemmadenia bella. *Apocynaceae.* Mexico. Pure white. 4–6. (C.)

Steriphoma paradoxa. *Capparidaceae.* Venezuela. Crimson to orange. 4–5. Climbing sh.; long, lanceolate leaves. Very striking. (C. or S.)

Stifftia chrysantha. *Compositae.* Brazil. Fl's. orange to yellow, in large brush-like heads. 10–15. Remarkable sh. or small tree. (S. or lay.)

Strobilanthes coloratus. *Acanthaceae.* E. Himalaya. Purple. 4–5. (C.) Many other species. See *Upcountry Selections.*

Stromanthe sanguinea. *Scitamineae.* Brazil. Crimson. 3–4. (Div. or S.)

Strophanthus dichotomus. *Apocynaceae.* India and Malaya. Purplish-white; corolla lobes developed in long, sinuate, tail-like forms. 5–6. (C.) (= S. longicaudatus.)

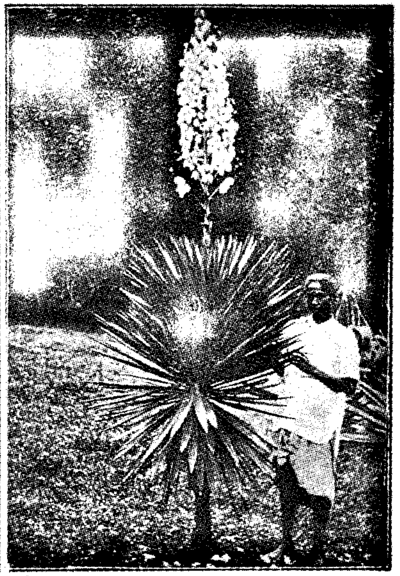
Tabernaemontana coronaria. Wax-flower. *Apocynaceae.* India and Malaya. Pure white, contorted petals, free-flowering; also a double var. 5–6. (C.)

Tecoma stans. *Bignoniaceae.* S. Amer. and W. Indies. Small tree or sh. Bright yellow bell-shaped fl's. 10–15. **T. velutina.** Mexico. Yellow. 8–12. Similar to latter, but lvs. more finely cut. (C. or S.)

Tephrosia grandiflora. *Leguminosae.* S. Africa. Purplish-red. 2–3. (S.)

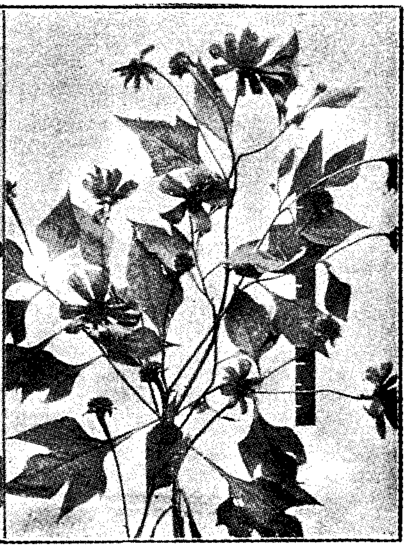
Stifftia chrysantha.
Orange-yellow flowers.

Thunbergia erecta.
Flowers violet-purple.



ADAM'S NEEDLE (*Yucca gloriosa*).

Uroskinnera spectabilis.
Flowers deep mauve.



Tithonia diversifolia.
Flowers large, yellow.

Thespesia macrophylla (= **T. Lampas**). *Malvaceae.* Ceylon, Trop. Asia and Africa. Large, bright yellow, with dark crimson centre. 5–6. (C. or S.)

Thevetia nereifolia. *Apocynaceae.* Trop. Amer. Stems milky; lvs. semi-linear, 4–5 in. Fl's. yellow or orange. 10–15. (C. or S.) See p. 205.

Thunbergia affinis. *Acanthaceae.* Trop. Africa. Violet-purple, tube white or yellow. 4–5. (C.) **T. (Meyenia) erecta.** Trop. Africa. Deep purplish-blue, tube yellow. 4–5. (C.)

Thyrsacanthus rutilans. *Acanthaceae.* Colombia. Crimson, drooping fl's. 5–6. (C.)

Tithonia diversifolia. Mexican Sunflower. *Compositae.* Mexico. Large, bright yellow fl's. 6–8. (S.) Nat. in Ceylon. See p. 112, also *Weeds.*

Uroskinnera spectabilis. *Scrophulariaceae.* Cent. Amer. L. oval, pubescent. Showy mauve fl's. in close racemes. 3–5. (C.) See p. 112.

Vernonia madagascariensis. *Compositae.* Violet-purple. 3–5. (C. or S.)

Warszewiczia (Calycophyllum) coccinea. Sh. or small tree. See *Flowering Trees.*

Woodfordia floribunda. *Lythraceae.* Ceylon, India, etc. Brick-red. 5–6. (C.)

Wormia Burbidgei. *Dilleniaceae.* Borneo. Large evergreen sh. or small tree; fl's. large, yellow, solitary. 8–12. (C.)

Wrightia zeylanica. Sudu-idda, *S.* *Apocynaceae.* Ceylon. Waxy, snow-white. Slender branches. 3–5. (C. or S.)

Yucca gloriosa. *Liliaceae.* Spanish Needle; Adam's Needle. Fl's. in large, erect, white, terminal panicle. L. long, rigid, sharp-pointed. See p. 112.

ORNAMENTAL FOLIAGE SHRUBS

See also pp. 142–149.

Abroma fastuosa. *Sterculiaceae.* Trop. Asia. 8–12. Large cordate lvs. (C. or S.)

Acalypha godseffiana. *Euphorbiaceae.* New Guinea. 3–4. L. ovate, white or cream-margined. **A. hamiltoniana.** L. small, semi-filiform, drooping, white-margined. 3–4. **A. illustris.** 6–8. Large lvs., blotched with copper and crimson. **A. marginata.** India. 6–8. Lvs. oval, serrate; margin cream or pink. **A. obovata.** Hort. 5–8. Similar to latter. L. generally obovate. **A. torta.** Fiji. 5–6. L. bronze, twisted. **A. tricolor (A. wilkesiana).** Fiji. 6–10. L. blotched with red and crimson. **A. triumphans.** 6–8. L. large, crimson and green. **A. Willinckii.** 6–8. L. very large, pale green, blotched with yellow. Several other species and var's. (C.)

Alchornea ilicifolia. *Euphorbiaceae.* Australia. 8–10. Holly-like spiny lvs. (C.)

Alpinia rafflesiana. *Scitamineae.* 4–5. L. variegated. (Div.) **A. sanderiana.** See *Ornamental Fol. Pot-Plants*, p. 142.

Amomum hemisphaericum. *Scitamineae.* Java. Tall, herbaceous, leafy stems, 8–10 ft. long, lvs. $1\frac{1}{2}$–2 ft. long, sinuate, bronze underneath. (S. or Div.) **A. magnificum.** Mauritius. 8–10. Similar to latter species, except that the lvs. are green on both sides. Fl's. in large pink heads, on erect stalks $2\frac{1}{2}$–3 ft. high.

Amomum magnificum.
Flowers in large pink heads.

Aralia filicifolia. *Araliaceae.* Pacific Islands. 6–8. L. large, pinnate and pinnatifid, yellow when young; very ornamental. (C.) See p. 142. **A. Balfouri.** L. pinnate, variegated; leaflets oval or circular, freely blotched with grey or white. **A. Guilfoylei.** Pacific. 6–8. Stems erect. Similar to latter, but leaflets smaller and less variegated. **A. maculata.** Polynesia. Stems and lvs.

1, *Aralia Balfouri*; 2, *A. filicifolia*; 3, *Panax fruticosum*.

purplish, with green spots. 8–10. L. large, roundish. **A. triloba.** L. 3-lobed. 4–6 ft. (C.) See also *Panax*, closely related.

Arundo Donax variegatum. *Gramineae.* S. Europe. Ornamental variegated grass. 6–8. (C. or Div.)

Bambusa. See *Bamboos and Orn. Grasses.*

Beaucharnia (Nolina) recurvata. *Liliaceae.* Mexico. 5–8. Dracaena-like plant, stem swollen at base. (S. or Off.)

Boehmeria pulchra. *Urticaceae.* 5–6. L. cordate, dentate, dark green sheen. (C.)

Carludovica palmata. Panama-hat Plant. *Cyclanthaceae.* Bushy plant with large, handsome palm-like lvs. (Div.) See *Fibres*.

Chamaeranthemum Beyrichii variegatum. *Acanthaceae.* Brazil. 2–3. L. variegated. (C.)

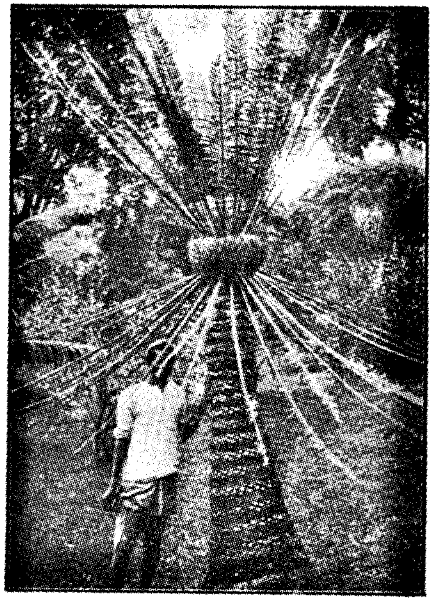
Coccoloba. See *Muehlenbeckia*.

Codiaeum (Croton). *Euphorbiaceae.* Malaya, Polynesia, etc. Numerous var's. 5–7. Highly ornamental sh., lvs. variously coloured and shaped; suitable for hedges, borders, etc. (C.)

Cordyline (Dracaena) terminalis, and other spp. *Liliaceae.* Australia, Pacific Is., etc. Very elegant palm-like plants, in many garden var's., usually erect and unbranched, many with highly coloured large purple, crimson or pink lvs. 6–12 or more. Prop. by stem- or leaf-cuttings, or suckers. **C. cannaefolium, C. Duffii, C. Fraseri, C. magnifica,** etc.

Cycas circinalis, Madu, *S.* Ceylon Sago. *Cycadeae.* Ceylon, India, etc. Handsome, slow-growing plant, bearing a crown of long pinnate lvs. 6–12. The large seeds are made into a sago. (S. or Off.) **C. pectinata.** Burma. Basal scale-lvs. cordate, brown, and toothed. **C. revoluta.** Japan. Dwarf species with compact, dark green lvs. **C. Rumphii.** Moluccas.

CEYLON SAGO (*Cycas circinalis*).



Cycas pectinata.

6–8. Large robust species; male plant not found in Ceylon, therefore fertile seeds not known to be produced here. **C. siamensis.** Cochin China. 4–6. Numerous other spp. (Off. or Su.)

Cyclanthus cristatus. *Cyclanthaceae.* Colombia. Stemless plant with long binate lvs. 4–5 ft. long. (Su.)

Dioon edule. *Cycadeae.* Mexico. Slow-growing plant with sharp-pointed leaflets. The stout stem affords edible fecula.

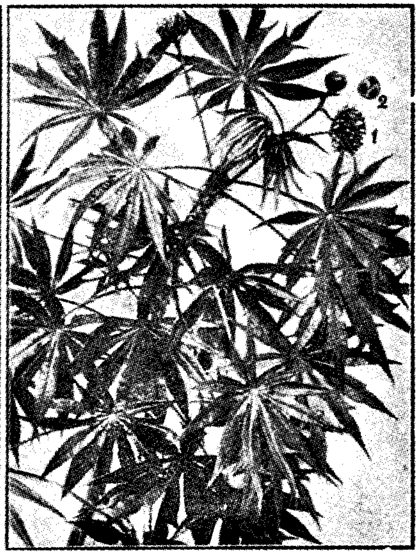
Dracaena reflexa. *Liliaceae.* Trop. Africa. Much-branched sh. or small tree with small green lvs. 10–15. Remarkable as a branching Monocot. Also a variegated form. **D. thalioides.** L. long, erect. 6–8. Fl's. greenish-white. (C. or S.)

Encephalartos Caffra. *Cycadeae.* Slow-growing, Cycas-like plant, with long pinnate, spiny lvs. 5–10. (S. or Off.) S. Africa. Several spp., including **E. Hildebrandtii, E. horridus, E. villosus,** etc.

Eranthemum elegans. *Acanthaceae.* Erect sh. 4–6. L. blotched with white, grey, bronze, etc. See p. 145.

Erythrina Parcelli. 8–15 or more. L. with creamy-white bands. (C.)

LOBSTER CLAW (*Heliconia brasiliensis*). Showing scarlet spikes.



Jatropha multifida. (1) Flower-head; (2) fruit in section.

E. vespertilio. W. Australia. Small tree or sh., with 3 peculiar bat-like, obversely triangular leaflets. (S. or C.)

Excaecaria bicolor. *Euphorbiaceae.* Java. 5–7. L. small, ovate, deep crimson beneath. (C.)

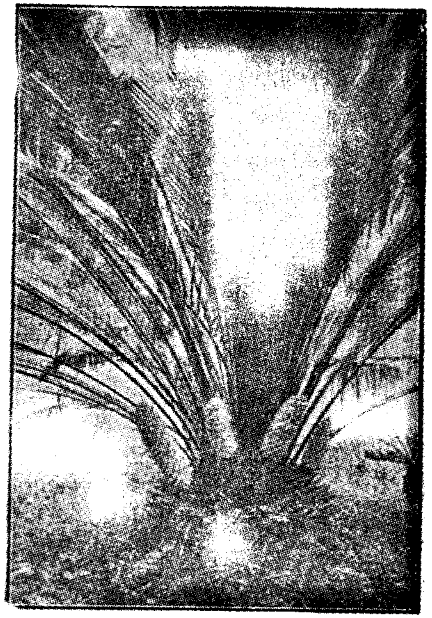
Goldfussia anisophylla. *Acanthaceae.* Himalaya. 3–4. Close bush, small lvs. (C.)

Gomphocarpus fruticosus. *Asclepiadeae.* S. Africa. 4–5. Fl's. white; fruit hairy, hollow, balloon-like.

Graptophyllum hortense. Caricature Plant. *Acanthaceae.* Trop. Asia. 4–5. L. variegated, blotched creamy-white. (C.)

Gynura bicolor. *Compositae.* Herb. sh. L. ovate with violet hairs. 4–5. (C.)

Heliconia angustifolia. *Scitamineae.* Brazil. 5–6. L. large, banana-like. **H. aurea-striata.** **H. brasiliensis.** Lobster-claw. Brazil. 5–6. Remarkable for large, scarlet, distichous fruit-spikes. **H. brevispatha.** S. Amer. 4–6. L. long and narrow; fl's. white, spathes orange-red. **H. illustris.** Hort. **H. insignis.** 5–8. L. deep bronze,



Macrozamia Moorei.
Showing fruit cones.

Nandina domestica.

long, narrow, wavy, handsome. (Su.) **H. metallica.** Colombia. 4–5. L. bronze, recurved. **H. pulverulenta.** S. Amer. 4–6. L. white and powdery beneath. **H. spectabilis.** 4–6. L. bright bronze. (Div. or S.) See p. 115.

Honckenya ficifolia. *Tiliaceae.* 3–5. Deep copper-coloured lvs. (S. or C.)

Jatropha multifida. Coral-bush. *Euphorbiaceae.* 5–15. Palmately-divided lvs.; fruit bright red; ornamental. (S. or C.) See p. 115.

Justicia grandiflora. *Acanthaceae.* 4–5. Ornamental foliage plant. (C.)

Leea amabilis. *Ampelideae.* Borneo. 4–6. Ornamental pinnate lvs. with white or pinkish-grey midrib and nerves. **L. coccinea.** Burma. Similar to above. (C. or S.)

Macrozamia Fraseri. *Cycadeae.* W. Australia. 5–7. Large handsome, closely pinnate lvs.; pinnae narrow and sharp-pointed. (S. or Su.) **M. Moorei.** Queensland. Similar to above. **M. plumosa** and several other spp.

Miconia flammea. *Melastomaceae.* Trop. Amer. 4–5. Handsome sh. with large rugose lvs. **M. magnifica.** Large sh. or small tree, 15–20; very large, handsome ovate lvs., with satiny sheen and 3 main prominent pale green nerves; surface rugose. Fl's. creamy-white in large panicles. (See fig.) **M. pulverulenta** (= **M. Hookeriana**). Peru. Large sh. or small tree, 15–20; large, handsome, ovate lvs., satiny purple beneath; prominent nerves; fl's. in large, creamy-white, erect panicles. (C.)

Muehlenbeckia (Coccoloba) platyclada. Centipede Plant. *Polygonaceae.* Solomon Islands. 5–7. Straggling, leafless climbing sh., with flat, green, ribbon-like branchlets. (C.)

Myriocarpa longipes. *Urticaceae.* Costa Rica and Mexico. 8–10. Lvs. large, oval, hispid. Fl's. in long pendulous green filiform tails.

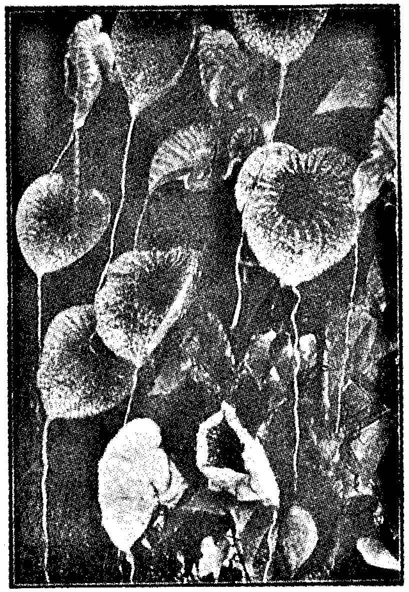
Nandina domestica. *Berberideae.* China and Japan. 5–7. Lvs. small, bipinnate, tinted bronze; erect, numerous stems. (Su. or S.)

Miconia magnifica.
Very large beautiful leaves with satiny sheen.

BRIDAL BOUQUET (*Porana volubilis*).

CORALLITA (*Antigonon leptopus*).
A beautiful pink-flowered creeper.

Panax fruticosum. *Araliaceae.* Trop. Asia. 4–6. Quick-growing; handsome, feathery, bipinnate lvs. (C.) See *Aralia*, closely related to *Panax*.
Pandanus sanderiana. Hort. *Pandanaceae.* 4–10. Long, arching, handsome lvs., striped creamy-yellow and green. **P. variegatus.** Java. Lvs. long, narrow, spiny; variegated white and green. (Off.)
Phyllanthus myrtifolius. Ceylon Myrtle. *Euphorbiaceae.* 5–6. Small, myrtle-like lvs.; slow-growing, makes an excellent hedge or edging. (S.) **P. nivosus.** See p. 146.
Pisonia alba. Lettuce Tree. 10–20. Pale yellow foliage. See p. 92.
Sanchezia nobilis. *Acanthaceae.* Ecuador. 5–6. Long lanceolate lvs. with creamy-white bands. **S. glaucophylla.** Similar to latter, but variegation less pronounced. (C.)
Sesbania aegyptiaca. *Leguminosae.* Tropics. 6–10. Fine foliage, bipinnate lvs. Quick growing; specially suited to sub-tropics, also for green manuring. (S.)
Sophora tomentosa. *Leguminosae.* Mudu-murunga, *S.* Ceylon, etc. Whole plant woolly-grey. (S. or C.)
Stangeria paradoxa. *Cycadeae.* Natal. Small plant with short stout trunk and fern-like foliage. Distinct from other Cycads.
Strelitzia augusta. *Scitaminae.* S. Africa. Herb. per.; large Banana-like lvs.; numerous slender stems. 15–20. (Su. or S.)
Thunbergia Kirkii. *Acanthaceae.* Trop. Africa. 3–4. L. small, closely set, pinnate; fl's. blue. (C.)
Vernonia macrophylla. *Compositae.* Brazil. 6–8. Large oval lvs. (S.)
Zamia latifolia and other spp. *Cycadeae.* Mexico, S. Africa, etc. Small palm-like plants with stiff pinnate lvs. (Su.)



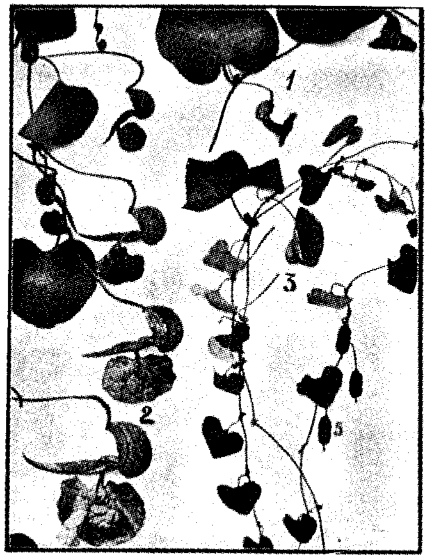
GIANT FLY-CATCHER (*Aristolochia gigas*).

ORNAMENTAL FLOWERING CLIMBERS

(See also pp. 124, 181.)

Acridocarpus natalitius. *Malpighiaceae.* Natal. Bright yellow. L. leathery, ovate. (C.)
Adenocalymna nitidum. *Bignoniaceae.* Brazil. Yellow. L. trifoliate; tendrilled. (C.)
Allamanda cathartica. Willow-leaved Allamanda. *Apocynaceae.* Guiana. L. in whorls; fl's. bell-shaped, bright yellow; quick-grower. (C.) See p. 181.
A. Hendersoni. Brazil. Yellow. Similar to, but more robust than, preceding sp., with larger fl's. **A. nobilis.** Yellow, large fl's. Several other spp. and var's.
Antigonon insigne. *Polygonaceae.* Colombia. Bright rose-pink; large double fl's. (C.) **A. leptopus.** Corallita. Mexico. Bright pink. Beautiful climber; numerous tendrils; suitable for arbours, pergolas, etc. Also a white-flowered var. (C. or S.)
Araujia grandiflora. *Apocynaceae.* Brazil. White, tubular, scented fl's. (C.)
Aristolochia elegans. *Aristolochiaceae.* Brazil. Fl's. saucer-shaped, mottled dark purple and creamy-yellow; very elegant. (S.) See p. 119.
A. gigas (var. Sturtevantii). Giant Fly-Catcher; Pelican- or Goose-flower. Guatemala. Fl's. (perianths) very large, with long tail (20–24 in.), greenish-white, mottled brown; strong offensive odour, attracting numerous flies, on which the plant depends for pollination. (C.) **A. hians.** Venezuela. Spotted purple and

green; fl's. 2-lobed. **A. labiosa.** Brazil. Fl's. purplish-brown and green, with large, peculiar, broad lip. **A. ridicula.** Brazil. Fl's. greenish-brown, developed into 2 horn-like projections, tipped with rigid knobbed hairs; self-sterile. **A. saccata.** Himalaya. Purplish-red. Large, ovate, hairy leaves. (C.)
Asparagus falcatus. Hatawariya, *S.* *Liliaceae.* Ceylon. Fl's. creamy-white, in large panicles, sweet-scented; spiny. Cladodes 3–4 in. long. (S. or Tu.)
Banisteria fulgens. *Malpighiaceae.* W. Indies. Yellow. See p. 75. **B. laurifolia** (= **Stigmaphyllon periplocaefolium**). Bright yellow. (C.)
Beaumontia grandiflora. Nepal Trumpet Flower. *Apocynaceae.* India. Large white, trumpet-shaped fl's. Strong grower. (C.)
Bignonia magnifica. *Bignoniaceae.* Colombia. Magenta; vigorous grower, very showy; frequent bloomer. L. of this and other spp. usually binate, with forked and hooked tendrils. (C.) **B. Unguis-cati.** Trop. Amer. Bright yellow; fl's. in great profusion after dry season; a gorgeous sight when in fl. and draping tall trees. Creeping by clawed tendrils; slender stems. (S. or Su.) **B. venusta.** Tanga-poo, *T*; Golden Shower. Brazil. Fl's. bright orange, tubular, 2–3 in. long, in pendulous clusters. Blossoms in dry season in great profusion; remarkably beautiful. (C.) See below.
Bougainvillea glabra. *Nyctagineae.* Brazil. Bright purple bracts: very showy. Spiny stems, strong grower; likes sunny place. (C. or S.) **B. glabra var. sanderiana.** Dwarf, free-flowering var. of latter. (C.) **B. spectabilis var. laterita.** Brazil. Brick-red. Straggling shrub, very handsome when in fl. Several hybrids, different shades. (Lay.) See fig. on p. 198.
Callichlamys riparia. *Bignoniaceae.* Woody climber with beautiful yellow fl's. like those of Allamanda.
Camoensia maxima. *Leguminosae.* Trop. Africa. Fl's. 8–9 in. long, largest of family; white, fringed with yellow, scented. Strong grower. (C. or S.) See fig. on p. 120.
Cereus triangularis. Night-flowering Cactus. W. Indies. Epiphytic creeper with large, tubular, white fl's. Stems 3-angled. (C.)
Chonemorpha macrophylla. See p. 134.



FLY-CATCHING PLANTS
1, *Aristolochia ridicula*; 2, *A. labiosa*, showing enlarged lip; 3, *A. elegans*; 5, fruit pods of latter.

GOLDEN SHOWER, VENUS'S FLOWER (*Bignonia venusta*).

Bignonia Unguis-cati.
A beautiful plant when in flower.

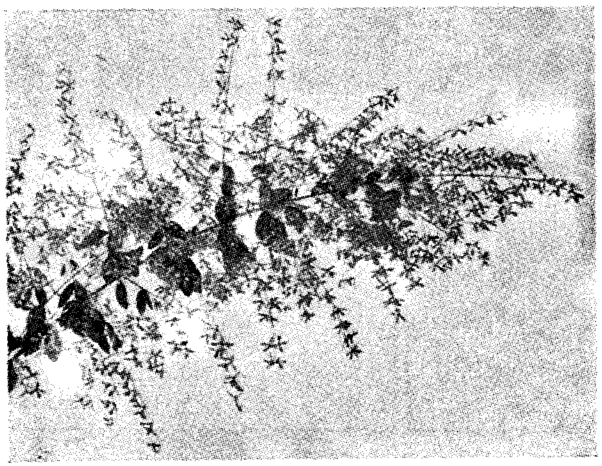
Camoensia maxima.
The largest of leguminous flowers.

Clerodendron Thompsonae. (**C. Balfouri.**) *Verbenaceae.* Trop. Africa. White fl's. with scarlet projecting stigmas. Lovely plant; slender. (C.)

Clitoria ternatea. Katarodu-wel, *S.* *Leguminosae.* Large, blue, pretty fl's.; not a free bloomer. Also " double " and white var's.

Congea tomentosa. *Verbenaceae.* Burma. Bears large loose sprays, Sept. to Feb., composed of mauve-pink velvety bracts in 4's, resembling petals, lasting several months. Beautiful cl. See fig. (C.)

Dipladenia amabilis. Hort. *Apocynaceae.* Rosy-crimson, very showy. (C.) Several spp., including **D. flava.** Colombia. Yellow; and **D. splendens.** Brazil. Rose-pink.



Congea tomentosa.
A beautiful pink-flowering climber. The coloured calyces remain long after the corollas have fallen.

Gloriosa rothschildiana. *Liliaceae.* Crimson and yellow, large fl's. Beautiful herbaceous twiner. (Tu.) See below. **G. superba.** Niyangala, *S.* Ceylon, Trop. Asia and Africa. Scarlet and yellow, very showy. (Tu.) See *Poisonous Plants*. **G. virescens.** Trop. Africa. Greenish-red. (Tu.)

Hidalgoa Wercklei. *Compositae.* Costa Rica. L. small, succulent, deeply cut and toothed; fl's. orange-scarlet. (C.)

Hoya carnosa. Wax-flower. *Asclepiadeae.* Queensland. Pinkish wax-like fl's. in bunches. Thrives best on tree-trunks; medium elevations. (C.)

Ipomoea carnea. *Convolvulaceae.* Trop. Amer. Pale pink. Straggling, climbing sh., large fl's.; likes a sunny situation and sea-coast. (C.) **I. Briggsi.** W. Indies. Bright crimson; floriferous, very showy. (C.) **I. Learii.** Trop. Amer. Fl's. large, bright purplish-blue. L. trilobed. Beautiful plant, quick-grower; forms a screen rapidly, but dies down once a year. (C.) **I. palmata.** Trop. Africa. Purple. Small palmately divided lvs. (S. or C.) **I. Quamoclit.** Tropics. Small scarlet fl's., fine pinnate lvs. Annual. (S.) **I. tuberosa.** Spanish Arbour-vine. W. Indies. Yellow. Handsome, vigorous climber. (S. or Tu.) **I. Bona-nox.** See p. 135.

Jacquemontia violacea. *Convolvulaceae.* Mexico. Slender perennial; fl's. bright blue, small, bell-shaped; free bloomer. L. small, oblong-cordate. (C.)

Jasminum flexile. *Oleaceae.* Ceylon. Small, white, scented; trifoliate. **J. pubescens.** India, Burma, etc. Pure white, very fragrant. **J. revolutum.** Saban-pichcha, *S.* S. India. Yellow fl's.; climbing sh. **J. Sambac.** Arabian Jasmine; Pichcha; Geta-pichcha, *S*; Mallia-poo, *T.* Ceylon, S. India, etc. White, strongly scented. Semi-climbing sh. L. glabrous. (C.) See p. 107.

Gloriosa rothschildiana.
Beautiful herbaceous twiner.

Lonicera hildebrandiana. *Caprifoliaceae.* Burma. Yellow. Largest-flowered Honeysuckle. Herbaceous twiner. (C.)

Macrosphyra longistyla. *Rubiaceae.* W. Trop. Africa. Creamy-white; very long style (3–4 in.); stigma covered with sticky yellow fluid; strong odour. (C.)

Manettia bicolor. *Rubiaceae.* Brazil. Small twining sh.; fl's. scarlet, tipped yellow. (C.)

Naravelia zeylanica. *Ranunculaceae.* Ceylon, India, etc. Fl's. dingy white. Thrives best on tree-trunks. (C.)

Nycticalos Thomsoni. *Bignoniaceae.* Assam. White. Beautiful plant. (C.)

Odontadenia speciosa. *Apocynaceae.* S. Amer. Salmon-yellow. Fl's. fragrant and showy. Does not seed in Ceylon. (Lay.) See over.

Oxera pulchella. *Verbenaceae.* New Caledonia. Greenish-white; showy. (C.)

Passiflora coerulea. *Passifloraceae.* Brazil. Bluish-purple. L. 3–5 lobed. (C.) **P. holosericea.** S. Amer. Purplish-blue. L. entire, lanceolate. (C.) **P. Jenmani.** Guiana. Creamy-yellow. L. 5–7-lobed. (C.) **P. laurifolia.** Trop. Amer. Purple and violet. L. oval. See p. 125. **P. racemosa.** Brazil. Scarlet. L. glaucous beneath. **P. violacea.** Purple-lilac. Beautiful sp. **P. vitifolia.** Panama. Beautiful, scarlet, large fl's. L. 3-lobed. (C.)
Pereskia Bleo. *Cactaceae.* Mexico. Large spiny cl., pink fl's. (C.)
Pergularia odoratissima. Tonkin Creeper. *Asclepiadeae.* China and Sumatra. Greenish-yellow, fragrant. Fruit large, winged. (S. or C.)
Petrea volubilis. *Verbenaceae.* Trop. Amer. Fls. in racemes; corolla violet, calyx bright heliotrope, remaining long after the corollas have fallen. Beautiful plant; flowers twice a year. (C.) See below.
Porana paniculata. Horse-tail Creeper. Corallila. *Convolvulaceae.* India, Java, etc. Greenish-white, long sprays. Large cl. (C.) **P. volubilis.** Bridal Bouquet. Malaya. Creamy-white, large panicles. Very handsome when in full flower. (C.) See p. 117.
Quisqualis indica. Rangoon Creeper. *Combretaceae.* S. India and Malaya. Semi-climbing sh. Fl's. pale pink to deep crimson, in drooping clusters. (C.) See p. 124.
Raphistemma pulchellum. *Asclepiadeae.* Assam and Burma. Fl's. waxy white, in numerous clusters. L. large, heart-shaped. (C.)
Rhodochiton volubile. *Scrophulariaceae.* Mexico. Bright-red. 8–10. (C.)
Roses, Ramblers, etc. See p. 184.
Roupellia grata. Cream-fruit. *Apocynaceae.* Trop. Africa. White, suffused with crimson; close bunches, scented. Strong grower. (S. or C.)
Senecio hederaefolia. *Compositae.* S. Africa. Yellow. Herb. cl., with small Ivy-like lvs. Sometimes known as "German Ivy." (C. or S.)

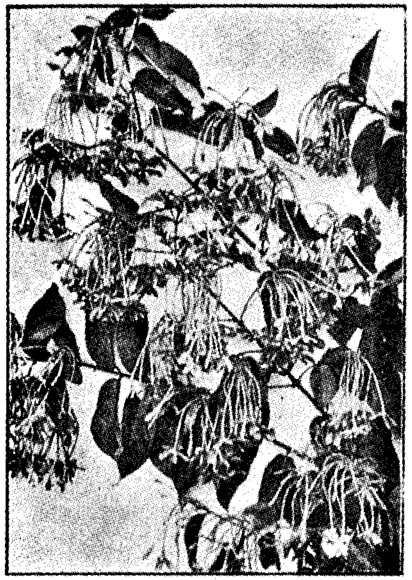
Odontadenia speciosa.
Salmon-yellow, scented flowers.

Petrea volubilis.
Violet and heliotrope flowers. One of the most beautiful of flowering plants.

Raphistemma pulchellum. Flowers creamy-white.

Solandra macrantha. *Solanaceae.* Creamy-yellow. (C.) See p. 182.
Solanum pensile. *Solanaceae.* Brazil. Dark-blue. (C.) **S. seaforthianum.** Slender vine; drooping panicles of purplish-blue fls. Lvs. much divided. Brazil. **S. Wendlandii.** Giant Potato-climber. Costa Rica. Bluish-purple, large panicles. Vigorous grower, petioles and leaves prickly; very showy. (C.)
Stephanotis floribunda. *Asclepiadeae.* Madagascar. Waxy white, tubular fl's., strongly scented; popular for bouquets, etc. Thrives best in tubs. (C.)
Stigmaphyllon (Banisteria) ciliatum. *Malpighiaceae.* Brazil. Yellow fl's. *Banisteria.* **S. periplocaefolium (Banisteria laurifolia).** India. Bright yellow. (C.)
Strophanthus hispidus. *Apocynaceae.* Trop. Africa. Corolla lobes developed into long tails. (C.) See p. 125.
Thunbergia grandiflora. *Acanthaceae.* Malaya. Bluish-mauve, large fl's.; quick-growing, immense climber. (S., C., or Tu.) Also a white-fl'd. form, which is less robust. See p. 124.
Tristellateia australis. *Malpighiaceae.* Malaya, etc. Yellow, erect racemes; elegant and free bloomer. (C.)
Wagatea spicata. *Leguminosae.* India. Fl's. in scarlet spikes. Vigorous grower, very thorny; lvs. pinnate. (C. or S.)

GIANT POTATO-CREEPER (*Solanum Wendlandii*).
Flowers large, bluish-purple.



" Rangoon Creeper " (*Quisqualis indica*).
Flowers pale pink to deep crimson.

Thunbergia grandiflora.
Flowers pale blue to mauve. Forms enormous curtain on trees, etc.

ORNAMENTAL-LEAVED CLIMBERS

Argyreia speciosa. Elephant Climber. *Convolvulaceae.* Bengal, Java, etc. Vigorous grower; lvs. large, cordate, silvery-white beneath. Fl's. purple. (C.)

Aristolochia leuconeura. *Aristolochiaceae.* Colombia. L. large, white-veined. (C.) **A. trilobata.** W. Indies. L. 3-lobed. (C.)

Asparagus plumosus. *Liliaceae.* S. Africa. Asparagus Fern. Handsome fern-like foliage. **A. Sprengeri.** Natal. Filiform " leaves " (cladodes), about 1 in. long, 3–4 in each whorl. (S. or Tu.)

Bauhinia diphylla. *Leguminosae.* Malaya. L. small, 2-lobed; a straggling, climbing shrub. (C.)

Bignonia argyreo-violascens. Hort. *Bignoniaceae.* L. prettily marked, veins white, violet in young state. (Su.)

Buddleia madagascariensis. *Loganiaceae.* Fl's. orange, in terminal panicles; lvs. silky-white beneath. (C.) Madagascar.

Cardiospermum Corindum. Balloon Vine. *Sapindaceae.* Ceylon. Annual with delicate bi-ternate (twice trifoliate) leaves and small white fl's., in clusters. (S.)

Cissus (Vitis) discolor. *Ampelideae.* Java. Young lvs. tinted violet and purple. Requires shade. (C.)

Dioscorea argyrea. *Dioscoraceae.* Colombia. Large variegated lvs. **D. multicolor.** Similar to preceding species. (C. or Tu.)

Echites rubro-venosa. *Apocynaceae.* Brazil. L. with pink veins. (C.)

Geitonoplesium cymosum. *Liliaceae.* Queensland. L. strap-shaped, distichous; fl's. in small white clusters. (S. or Su.)

Ipomoea sinuata. *Convolvulaceae.* Trop. Amer. L. deeply cut. (S. or C.)

Mimosa argentea. Small bipinnate lvs., silvery-white midrib. (C. or S.)

Muehlenbeckia (Coccoloba) platyclada. See *Orn. Fol. Shrubs.*

Strophanthus hispidus.
Showing flowers developed into long tails.

Nepenthes distillatoria. Pitcher Plant. Leaf-tips formed into " pitchers." Moist shady situation. (C. or Su.) See p. 135; also *Insectivorous Plants.*

Passiflora laurifolia. *Passifloraceae.* Trop. Amer. L. lanceolate, evergreen; excellent for screens. (C.) **P. trifasciata.** Brazil. L. variegated, purplish beneath, trilobed. (C.) See pp. 74, 122.

Paullinia thalictrifolia. *Sapindaceae.* Brazil. A small plant with fine fern-like foliage. (C.)

Pothos. See *Creepers.*

Smilax argyraea. *Liliaceae.* Bolivia. L. large, oval, spotted white; prickly stems. (Su. or S.) **S. officinale.** Colombia. Large, shiny, ovate lvs. (Su.) See *Drugs.*

Vitis incisa. *Ampelideae.* Texas. L. much cut. **V. voinerriana.** Tonkin. Large, rather succulent, trifoliate, pubescent lvs. (C.)

ORNAMENTAL CREEPERS

Suitable for Tree-trunks, Walls, etc.

Epipremnum mirabile. Tonga-creeper. *Aroideae.* Malaya, Fiji, etc. Large epiphytic creeper; very large pinnatifid handsome lvs. (C.)

Ficus pumila. *Urticaceae.* China and Japan. Small-leaved, ivy-like creeper. **F. repens** (= **F. stipulata**). China and Japan. Similar to preceding sp. (C.)

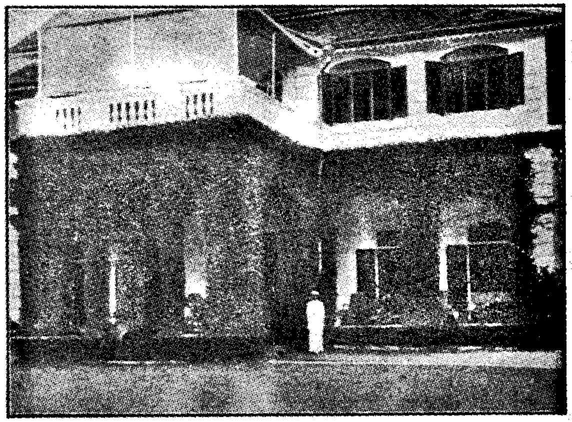
Impatiens repens. Whole plant purplish-crimson; fl's. bright yellow. Excellent for rockeries. (C.) Ceylon.

Marcgravia paradoxa. *Rubiaceae.* Large, handsome, 2-ranked lvs.; stems adhere to walls, etc., like Ivy. (C.)

Monstera deliciosa. A noble vigorous creeper; huge leathery, perforated and pinnatifid lvs. See *Trop. Fruits.* **M. acuminata.** Trop. Amer. L. immense, 4–6 long, pinnate. Creeper on trees.

Philodendron andreanum. Hort. *Aroideae.* Very large, handsome, satiny lvs. **P. erubescens.** Venezuela. L. coppery beneath. (C.) **P. squamiferum.** L. and petioles with glandular pinkish hairs. (C.) See fig. p. 142.

Pothos argenteus. *Aroideae.* Borneo. Lvs. ovate, silvery-grey. **P. aureus.** "Colombo Agent." Solomon Is. Immense epiphytic creeper. L. very large, oval, blotched with yellow. Thrives in moist shade. (C.)



Ficus repens. Ivy-like creeper.

Rhaphidophora decursiva. Dadakehel, *S.* *Aroideae.* Ceylon, India, Java. Large handsome creeper, on tall trees, in moist shady locality. Very large, deeply cut, dark-green lvs. (C.) See View in Fernery, Peradeniya Gardens, p. 151. **R. pertusa.** Malaya, etc. L. perforated, smaller than the above. (C.)
Scindapsus argyraea. *Aroideae.* Philippines. L. coriaceous, with grey spots.

LIANES OR GIANT CLIMBERS

A feature of tropical vegetation is the prevalence of enormous climbers or creepers, commonly known as lianes or liana. Though not suited to a garden of ordinary size, they form picturesque objects where sufficient space is available. Many are very remarkable on account of their immense woody stems, which wind snake-like round trees to a great length, or spread in contorted masses over the ground until they find support. Most climbers twine in a definite direction, either from left to right or *vice versa*; very few twine in both directions alternately. Among the more striking lianes are:

Salacia reticulata. Jungle ropes.

Anodendron paniculatum. Enormous snake-like climber.

Anamirta paniculata (= Cocculus indicus). Titta-wel, *S.* *Menispermaceae.* Large woody twiner, furrowed bark; seeds bitter and poisonous.
Anodendron paniculatum. Dul or Aswel, *S.* *Apocynaceae.* A very large twiner; bears pods 4–6 in. long, black when ripe, containing small flat seeds, each attached to a long, white, silky coma.

Bauhinia anguina. Snake Climber. *Leguminosae.* A remarkable wide-spreading sp., with flattened serpentine stems, strongly curved in alternate directions between the nodes; climbing by hooked tendrils. L. binate. **B. Vahlii.** "Maloo" of India. A huge climber, with very large, tough, roundish lvs., each up to 12 in. or more in diameter, sometimes used for plates in India.
Caesalpinia Nuga. Diya-wawuletiya, *S.* *Leguminosae.* A large woody climber with yellowish-grey bark; fl's. yellow.
Calamus. See *Rattans.*
Celastrus paniculatus. Duhudu, *S.* *Celastraceae.* Bright yellow fruits. See p. 365.
Cocculus macrocarpus. Large woody climber, with broad, oval lvs.
Derris scandens. Kala-wel, *S*; Tekil, *T.* *Leguminosae.* A strong, woody climber with smooth bark. Fl's. pure white, in large masses; ornamental.
Distictis lactiflora. *Bignoniaceae.* Extensive woody climber of S. America.
Entada polystachya. Trop. Amer. Enormous climber; small pinnate lvs. **E. scandens.** Elephant Climber; Pus-wel, *S.* *Leguminosae.* An immense woody climber, often with stems twisted like a corkscrew; bears large flat pods, 4–5 ft. long and about 4 in. broad, containing very large, hard, brown, flat seeds. This is the largest pod known.
Salacia reticulata. Himbutu-wel, *S.* *Celastraceae.* Large, woody climber. Pulp of fruit edible. See *Ceylon Med. Plants,* also fig. on p. 126.
Securidaca volubilis. *Polygalaceae.* A wide spreading climber of Trop. Amer. Fl's. small, bright purple, in large, loose panicles.
Toddalia aculeata. Kudu-miris, *S*; Kandai, *T.* *Rutaceae.* A very large woody climber with closely packed, large round prickles.
Willughbeia zeylanica. Kiri-wel, *S.* *Apocynaceae.* A large woody sp., climbing by means of long whip-like leafless shoots. Bears handsome bright pink, large, round, smooth fruit. Stems milky, yielding a sticky gum.

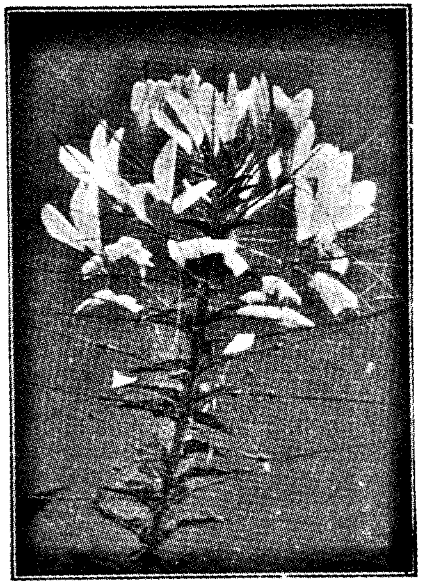
SHOWY ANNUALS AND PERENNIALS

Suitable for Flower-beds and Borders at Low and Medium elevations.

Ann. = annual; P. = perennial; Hp. = herbaceous perennial; Sh. = shrub.

Achimenes, different var's. See *Bulbous or Tuberous Plants.*
Ageratum, several var's. Ann. 1–1½. Fl's. blue. (C. or S.)
Alternanthera var's. *Amarantaceae.* Herb, ½–1. Foliage green or bronze. Useful for edging and pattern work. (C.)
Amarantus tricolor. Several var's. Ann. 2–4. Bears a crown of showy coloured lvs., crimson, yellow, etc. (S.)
Ananas sativus variegata. Variegated Pineapple. Hp. 1½–2. Variegated lvs. Useful for ornamental grouping. (Su.) See *Flower Garden.*
Angelonia salicariaefolia. *Scrophulariaceae.* Hp. 2. Fl's. bluish-purple, scented. (C.) **A. salicariaefolia alba.** 2. Fl's. white, scented; stands drought well. Fig. on p. 129.
Arundo Donax variegatus. 6–8. Handsome variegated grass; variegation best developed when grown in light sandy soil, without manure or shade. (Div.)
Aster, China. Numerous var's. Ann. 1–2. Shades of pink, purple, white, etc. (S.) **A. eminens.** Many var's. Hp. 1½–3. Fl's. pale blue or mauve.
Balsam, numerous var's. Ann. ½–1. Different shades, very showy. (S.)
Bartonia aurea. *Loasaceae.* Ann. 1½. Ornamental yellow fl's. (S.)
Begonia semperflorens. 1–1½. Showy, pale pink, etc. "Fairy Queen" (with coppery, shiny lvs.); several other fibrous-rooted or bedding var's. (C. or S.) **B. Bismarckii.** 2–3. Bright vermilion, free-flowering. (C.)
Browallia grandiflora. *Scrophulariaceae.* Ann. ½–1. Fl's. dark blue. (S.)
Caladium Humboldtii. Hp. ½–1. Small lvs., variegated white and green; effective for edging, designs, etc. See *Bulbs and Tubers.*
Calendula officinalis. *Compositae.* Ann. 1–1½. Fl's. orange-yellow, very showy.
Candytuft (*Iberis*). "White spiral," etc. *Cruciferae.* Ann. 1. Fl's. pure white, in large heads; also purple and other var's. (S.)
Canna, numerous var's. 2–4. Various shades, very showy. See *Bulbs and Tubers.*
Celosia cristata. Cock's-comb. *Amarantaceae.* Ann. ½–1. Fl's. in large heads, crimson, scarlet, etc. (S.) **C. plumosa.** Fl's. in plumes, not crested.

Chrysanthemum, border. Sevanthi-poo, *T*; Kapuru-mal, *S*. Hp. 1–3. Numerous var's. and classes, annual and perennial, double and single, white, yellow, reddish-brown, etc. (C. or Div.)
Cleome heptaphylla. *Capparideae.* Ann. 3–4. L. digitate, 7 leaflets. Fl's. white. (S.)
Coleus. Numerous garden var's. *Labiateae.* Hp. or ann. L. velvety and beautifully marked. **C. pumila.** Hp. ½–1. L. small, cordate, dark-brown, edged green. Fl's. purplish-blue. **C. thyrsoidea.** Bright blue. Small lvs. (C. or S.)
Coreopsis grandiflora. *Compositae.* Ann. 1. Fl's. yellow with brown centre. (S.) **C. tinctoria.** Ann. 1. Fl's. crimson, etc.
Cosmos bipinnatus. *Compositae.* Ann. 2–4. Fl's. pink or white. L. finely cut; very effective. (S.) **C. sulphureus.** Ann. 2–3. Fl's. orange-yellow; showy.
Dahlia. "Cactus," "Double" and "Single" var's. See *Up-country Plants.*
Dianthus chinensis. Indian Pink. *Caryophyllaceae.* Single and double var's. Ann. 1. Fl's. fringed white, pink, scarlet, etc.; very showy. (S. or Div.)



Gynandropsis speciosa.
Flowers bright pink.

Euphorbia pulcherrima. Poinsettia. Sh. Suitable for grouping, very showy. Cut back after flowering. (C.) See *Flowering Shrubs.*
Exacum macranthum. *Gentianaceae.* Bindara, *S*. Ann. 1–1½. Large, beautiful purplish-blue fl's. (S.) See *Ceylon Orn. Plants*; also p. 190.
Gerbera Jamesoni. Barberton Daisy; several var's. *Compositae.* Transvaal. P. 1. Large, star-like fl's., different colours, very showy. Fl's. partly close at night. Prefers rich humous soil and dry, sunny place. (S. or Div.)
Gomphrena globosa. Globe Amaranth; Bachelor's Button. *Amarantaceae.* Ann. 1. Free flowering; fl's. purple, in round heads. (S.)
Gynandropsis speciosa. *Capparideae.* Mexico. Ann. 2–3. Showy pink fl's.; also a white var. (S.)
Helianthus annuus. Sunflower, several var's. *Compositae.* Ann. 5–7. Very large yellow fl's., up to 10 or 12 in. across, dark brown centre. Dwarf "single" sorts, 3–4, are more ornamental and useful for cut flowers. (S.)
Hibiscus Trionium var. Annual prickly sh. with large fl's., bright crimson and other shades. (S.) **H. africana.** Ann. 3–5. Yellow.
Hippeastrum. Several var's. 1–1½. Fl's. large, scarlet, white, etc. Very showy. (Bulbs.) See *Tuberous Plants.*
Hollyhock (Althea rosea). *Malvaceae.* Ann. 4–6; rose, crimson, white, etc.; very showy. Single var's. best suited to tropics, thriving at medium or high elevations, especially in dry sub-tropics. (S. or C.) See p. 207.
Honckeyna ficifolia. Trop. Africa. Ann. sh. 3–5. L. bronze; fl's. coppery-red. (S. or C.) See *Fibre Plants.*
Impatiens Sultani. Sultan's Flower. *Geraniaceae.* Zanzibar. P. 1–1½. Showy scarlet or pink. (C. or S.) Named after Sultan of Zanzibar.
Marigold, African (Tagetes erecta). *Compositae.* Ann. 1½–2. Lemon-yellow. **M., French** (Tagetes patula). Ann. 1–1½. Orange, crimson, etc. (S.)
Nasturtium. See *Tropaeolum.*
Nicotiana affinis, numerous var's. Flowering Tobacco. Ann. 2–3. White, pink, etc. Very showy, especially **N. Sanderae** vars. (S.)
Pentas carnea. Several var's. Hp. or sh. See p. 129.
Petunia. See pp. 191, 194.
Phlox Drummondii. See p. 191.

Phrynium (Maranta) variegatum. *Scitamineae.* Variegated Arrowroot. Hp. 2. Large, variegated, ornamental lvs. (Tu. or Div.)
Plumbago capensis. Sh. 3–5. Fl's. beautiful delicate blue. (C.) See p. 110.

1, *Pentas carnea*; 2, *Angelonia salicariaefolia alba.*

Poinsettia. See *Euphorbia pulcherrima.*
Portulaca, several var's. *Portulaceae.* Ann. ½. Bright shades, pink, yellow, etc.
Rivina humilis. *Phytolaccaceae.* Ann. or P. sh. 3–4. Bears racemes of small bright red berries. (S.)
Ruellia acutangula. *Acanthaceae.* P. 1–2. Bright rose-pink. **R. formosa.** P. 2. Large, bright pink. **R. macrantha.** P. 2–3. Showy, rose-pink. **R. tuberosa.** P. 1½. Fl's. purplish-blue.
Salvia farinacea. *Labiatae.* P. 1½. Lavender-blue. S. splendens, var. "Scarlet Queen." Hp. or sh. 2–3. Bright scarlet. Several other spp. and var's. (S. or C.) See p. 111.
Scutellaria coccinea. *Labiatae.* P. 12–18. Fl's. scarlet, tubular, free-flowering. (C.)
Sedum sexangulare. *Crassulaceae.* Stonecrop. Hp. ½. Fl's. yellow; suitable for edging or rockery. (C.)
Sinningia speciosa. Wild Gloxinia. *Gesneraceae.* Hp. 2–3. Mauve or bluish-purple, bell-shaped. Likes shade and rich soil. (Tu. or Div.) See p. 133.
Siphocampylus Humboldtii. *Campanulaceae.* Hp. 1. Fl's. scarlet. (C.)
Telanthera sp. P. 1–2. Dark-purple velvety leaves, green when dried. (C.)
Torenia Bailloni. *Scrophulariaceae.* Ann. ½. Fl's. yellow. (S.) T. Fournieri. Ann. ½. Fl's. violet and pale blue; very pretty in a mass. (S.) Also a creamy white-fl'd. var.
Tropaeolum, dwarf and climbing var's. *Gesneraceae.* Ann. Fl's. orange and yellow; very showy. Prefers sunny situation. (S. or C.)
Turnera elegans. *Turneraceae.* P. 1½–2. Creamy-white with dark centre, closing at noon; free bloomer. **T. ulmifolia.** W. Indies. 2–3. Fl's. large, yellow. Nat. in Ceylon; common near sea-coast. (S. or C.) See p. 130.
Uroskinnera spectabilis. Sh. 3–4. Mauve, in bunches, very showy. See p. 112.

Torenia Fournieri.
Flowers pale blue, blotched with violet.

Verbena. Vervain. 1–1½. Many garden var's. See p. 192.
Vinca rosea alba. Madagascar Periwinkle. *Apocynaceae.* P. 2. Pure white. **V. oculata rubra.** White with pink centre. **V. rosea.** Rose-pink. (S.) Nat. along sea-coast in Ceylon.

Zinnia linearis. *Compositae.* Ann. 1. Orange-yellow. L. linear. Mexico. **Z.** "Fireball," and other var's. Ann. 1½–2. Fl's. double, scarlet, pink, mauve, and yellow; showy and free-flowering. (S.)

SELECTED BULBOUS OR TUBEROUS PLANTS

Suitable for Pots or Borders, up to 4,000 ft.

SEE ALSO SELECTION FOR UP-COUNTRY.

(Propagated by bulbs, tubers, or division, and in some cases also by seed.)

Achimenes grandiflora. Several other species or var's. *Gesneraceae.* Mexico. Small tuberous, showy flowering plants, suitable for hanging pots or shady borders. ½. Mauve, white, purple, and pale blue shades.

Turnera ulmifolia.
Flowers bright yellow.

Alocasia. See *Foliage Pot Plants.*

Amaryllis, "**Mrs. Garfield.**" *Amaryllideae.* 1½–2. Fl's. large, white, streaked with pink; very handsome. White band along centre of leaf. See *Hippeastrum.* **A. reticulatus.** Brazil. Scarlet. ½–1. L. with pale band in centre.

Amorphophallus campanulatus. Kidaran, *S. Aroideae.* S. India and Ceylon. Fl's. very large, purplish-brown, about 1–1½ ft., fœtid. Tuber very large, warted, edible, often cultivated in S. India. **A. Titanum.** Flower (spathe) 5 ft. high by 3 ft. across, dark purple, strongly fœtid. L. 10 ft. high. Sumatra.

Arisaema speciosa. Cobra Lily. Walkidaran, *S. Aroideae.* India and Ceylon. Greenish-purple. 2. Leaflets 5–7.

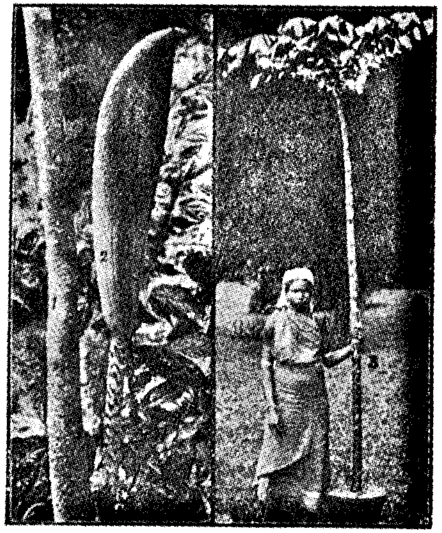
Belamcanda (Pardanthus) chinensis. Leopard Lily. *Irideae.* Orange, spotted brown. 1½. China.

Caladium. *Aroideae.* A family of low tuberous plants with large, ornamental, hastate-peltate lvs., mostly of S. American origin, including many beautiful hybrids. Require rich soil, well-decomposed manure, and abundance of moisture; thrive best in moderate shade, though many of the hardier vars. are also adapted for growing in open borders or beds. Prop. by suckers or division of the roots or tubers (corms). L. die down once a year, in dry season, after which the tubers should be kept in a fairly dry state. They may be left undisturbed in the ground if dry, or taken up and stored in dry earth or sand in a shed until the next season for planting. Following are a few of the best: **C. argyrites** (=**C. Humboldtii**). Small green and white variegated lvs.; excellent for edgings, ribbon borders, etc.; lvs. suitable for bouquets, etc. **C. bicolor.** L. bright pink with green margin, 1 ft., showy and distinct. Esteemed for beds and borders. "Baron Rothschild."—Dark crimson, spotted with rich pink, large lvs. "Candidum."—White, with bright green veins; excellent for borders and grouping. "Ashstead Beauty."—L. dark-rose, large, flecked pink and white. "Duchess of Fife."—White, netted with green and carmine. "His Majesty."—Creamy-white with green markings. "Pintado."—Pinkish-red with green margin. "Ladas."—Crimson with scarlet shading; small variety. "Peach Blossom."—Transparent pearly-white, blotched with pink and green. "R. Hoffman."—Rose-pink passing to white, bordered with green.

Callipsyche aurantiaca. *Amaryllideae.* S. Amer. Orange. 2. Other spp.

Canna. *Scitamineae.* A most showy class of flowering plants, with large handsome, green, dark-purple, or bronze lvs., 2–4 or more; readily prop. by tubers (Rhiz.). Easily cultivated and rapidly yielding a bright display of flowers. Deep cultivation, liberal manuring, abundant moisture, and replanting once in six months are necessary for best results. Planting may be done at almost any season, double shoots being placed about 20 in. apart. No shade is required, unless temporarily after planting if weather is hot and dry. There are numerous var's., obtained by hybridising or crossing. Two more or less distinct forms or classes are: *Orchid-flowered,* in which the flower segments are large and broad, but rather flaccid; and *Gladiolus-flowered,* with the segments smaller but firmer, and the flower-heads larger; these are generally more floriferous and lasting. Both forms include var's. with green, bronze or purple lvs. The following are a limited selection:

Orchid-flowered Cannas: "Austria," lemon yellow; "Italia," yellow ground, crimson centre; "Britannia," orange-yellow; "Kronos," orange and yellow; "H. Wendland," scarlet edged with yellow; "Roma," orange and yellow; "Phoebe," yellow ground, orange centre.



Dracontium gigas. A giant Aroid.
1, Leaf-stalk, 2, floral spathe,
3, single leaf from tuber in pot.

Gladiolus-flowered: "Circe," salmon-pink; "King George," cerise; "Bedouin," bright salmon; "Janus," yellow with numerous small brown spots; "Madame Crozy," scarlet, edged with yellow; "Windsor," deep crimson, large fl's. and heads; "Hungaria," bright pink, free-flowering, distinct; "California," bright orange, free-flowering; "R. Wallis," bright canary-yellow; "Alpha," salmon-pink, faintly edged with yellow, large loose heads; "Vice Reine," bright salmon-pink; "Jeanne d'Arc," pale cream, faintly netted with pink; "Louis Jittman," orange-salmon, broad segments; "Mont Blanc," pale cream, turning almost pure white; "Uncle Sam," deep crimson, broad segments, large heads; "Eureka," large, deep orange.

Bronze or purple-leaved: "Africa," fl's. orange-red; "Plato," fl's. deep red, lvs. dark purple; "Rhoea," fl's. orange-red; "Nero," fl's. large, bright orange-crimson, lvs. large, dark bronze, broad-pointed and striated, very handsome; "La France," fl's. scarlet with yellow throat; "Wyoming," similar to "Nero."

Crinum asiaticum. Tolabo, *S. Amaryllideae.* Trop. Asia. White; scented. 2. **C. augustum.** Mauritius. Pink and white. 2–3. **C. defixum.** India. White. 2. **C. erubescens.** Trop. Amer. White and purple. 2. **C. Moorei.** S. Africa. Pale rose. 1½. **C. Powelli.** Pale pink. 3–4. **C. speciosissimum.** Pure white. 2–3. **C. zeylanicum.** Ceylon. White. 2.

Dahlia. See p. 183. Very showy, especially the "Cactus" and "Single" forms.

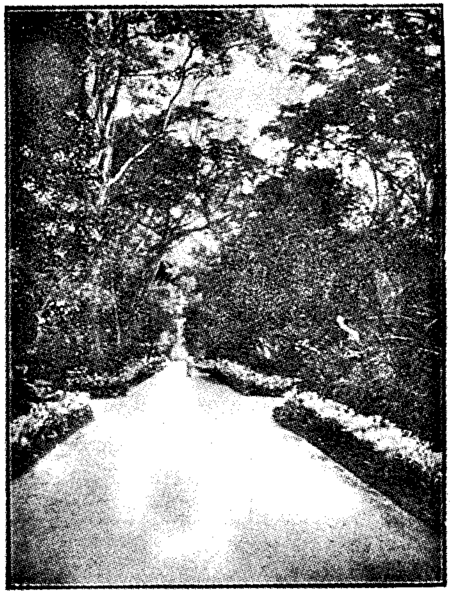
Dracontium (Godwinia) gigas. *Aroideae.* Nicaragua. Brownish-red. L. 8–10 ft. high; blade very large, deeply bipinnatifid; petiole stout, erect. Fl.-spathe 4–5 ft. high, mottled and striated. A remarkable plant. See above.

Drimiopsis Kirkii. *Liliaceae.* Zanzibar. Pale greenish fl's. L. small, fleshy, with brown spots.

Eucharis grandiflora. Eucharist Lily. *Amaryllideae.* Colombia. Pure white. 1–1½. **E. Sanderi.** Colombia. White. 1.

Eurycles amboinensis. Malaya, etc. *Amaryllideae.* White. 1–2. L. almost round. **E. Cunninghami.** Australia. White. 1.
Gesnera cardinalis. *Gesneraceae.* Brazil. Scarlet. 1½–2. **G. magnifica.** Brazil. Purple. 1–1½.
Gloriosa rothschildiana. See *Flowering Climbers.* **G. superba.** Niyangala, *S.* Trop. Asia. Beautiful herbaceous twiner, scarlet and yellow.
Gloxinia maculata. See *Sinningia.*
Griffinia hyacinthina. *Amaryllideae.* Very showy, large, bright amethyst-blue. 2. S. Amer.
Haemanthus Lindeni. *Amaryllideae.* Rosy scarlet. 1½. Congo. **H. multiflorus** (= **H. Kalbreyeri**). Trop. Africa. Scarlet. 1. See p. 133. Many other species.
Hippeastrum (Amaryllis) **equestre.** *Amaryllideae.* Fl's. large, bright red. Many hybrids and var's.; various shades of red to almost pure white. **H. "Mrs. Garfield."** A distinct and exceptionally fine var. See fig. opposite.
Hyline gardneriana. *Amaryllideae.* Trop. Amer. Pure white; blossoms after dry weather. 1–1½. See illustration below.

Hippeastrum var. *Garfield.*
A strikingly ornamental plant.



Hyline gardneriana.
Pure white "Lily" bordering Main Central Drive, Royal Botanic Gardens, Ceylon.

Hymenocallis ovata. *Amaryllideae.* W. Indies. 1. Long-pedicelled, pure white, delicate fl's., borne in cluster on stout stalk. **H. amoena, H. tenuiflora,** both of S. Amer.; pure white. Several other spp.
Isoloma (Tydaea) **amabile.** *Gesneraceae.* 1–2. Colombia. Dark-rose or crimson. **I. hirsutum.** W. Indies. Scarlet, orange-vermilion. 1–2. Other var's.
Kaempferia roscoeana. *Scitamineae.* Ceylon, India, etc. Bright pink, showy. 1. **K. rotunda.** Ceylon, India, and Malaya. Red and white. 1. Showy. **K. speciosa.** S. Amer. Violet-purple. 1. Other var's.
Lowia grandiflora. *Scitamineae.* Malaya. White. 2. **L. longiflora.** Perak. White and purple. 2.
Pancratium gloriosa. *Amaryllideae.* Trop. Amer. Pure white. 2. **P. zeylanicum.** Wal-lunu, *S.* Ceylon. Delicate, pure white. ½–1.
Polianthes tuberosa. Tuberose. *Amaryllideae.* Mexico. Fl's. very fragrant, creamy-white. 2–3.
Sinningia (Gloxinia) **speciosa.** Wild Gloxinia. *Gesneraceae.* Brazil. 2–3.

Haemanthus multiflorus.
A handsome scarlet-flowered species.

Wild Gloxinia
(*Sinningia speciosa*).

Sprekelia formosissima. *Amaryllideae.* Guatemala. Perianth deep crimson, bent to one side (declinate). 1.
Tacca laevis. *Taccaceae.* Trop. Asia, Africa, etc. 1½. Peculiar, brownish-purple, long thread-like projections from base of flower. See p. 149.
Tulbaghia violacea. *Liliaceae.* S. Africa. Purplish-violet. 1.
Zephyranthes Andersoni. *Amaryllideae.* Peru. Bright yellow, Crocus-like. ½–1. **Z. carinata.** "Rose Amaryllis." ½–1. Large, bright pink; very showy. Mexico and W. Indies. **Z. citrina.** Trop. Amer. Bright yellow. ½–1. **Z. tubispatha.** W. Indies. White. ½–1.

Rose Amaryllis (*Zephyranthes carinata*).
Forming masses of bright pink flowers, under shade of trees.

SOME ORNAMENTAL PLANTS INDIGENOUS TO CEYLON

(See also *Ceylon Orchids, Palms,* and *Ferns.*)

(L.c. = Low country ; I.e. = Intermediate elevations ; U.c. = Up-country ; Sh. = shrub ; Tr. = tree ; Cr. = creeper ; Cl. = climber ; Ep. = epiphyte ; Hp. = herbaceous perennial.)

Abutilon asiaticum. Anoda. *Malvaceae.* (L.c.) Sh., 2–4 ; fl's. yellow.
Acanthus ilicifolius. *Acanthaceae.* Swamps near sea-shore. Sh. 2–4 ; fl's. bright purplish-blue ; holly-like lvs.
Aeschynanthus zeylanicus. *Gesneraceae.* (U.c.) Sh.-cr., 2–3 ; fl's. orange-yellow.
Alocasia macrorrhiza variegata. *Aroideae.* (L.c.) Hp., 4–6 ; very large, variegated, hastate lvs., large portions of which are pure white.

Chonemorpha macrophylla.

Alpinia nutans, var. sericea. Rankiriya. *Scitamineae.* (L.c.) Hp., 5–6. Large lvs., 5–7 ; fl's. pinkish-white.
Alyxia zeylanica. *Apocynaceae.* (L.c.) Sh., 3–5 ; fl's. pale yellow.
Amorphophallus campanulatus. Kidaran. (L.c.) *Aroideae.* See p. 130.
Aneilema giganteum. *Commelinaceae.* (L.c.) Hp., 3 ; pale blue.
Anoectochilus regalis. Wanaraja. (Moist region ; I.e.) *Orchideae.* Hp. Ground orchid ; beautifully marked lvs. Moist shady jungle. See p. 141.
Barleria involucrata. *Acanthaceae.* (U.c.) Sh., 3–4 ; fl's. brilliant purplish-blue. **B. mysorensis.** Katu-nelu. (Dry region.) Sh., 3 ; fl's. bright violet-blue. **B. Prionitis.** Katu-karandu. (Dry region.) Sh., 2–3 ; fl's. pale orange-yellow.
Berberis aristata. *Berberideae.* (U.c.) Sh., 5–6 ; fl's. bright yellow.
Burmannia disticha. Ma-diya-jawala. *Burmanniaceae.* (L.c.) Hp., $1–1\frac{1}{2}$, bright yellow.
Calophanes Nagchana. *Acanthaceae.* (Dry region.) Sh., 3 ; fl's. pale blue.
Capparis zeylanica. *Capparideae.* (Dry region.) Sh., 6–8. Pink and white.
Cardiospermum Corindum. See p. 124.
Cassia auriculata. Matara Tea ; Ranawara. (L.c.) Sh., 4–6 ; bright yellow.
Chirita Moonii. *Gesneraceae.* (L.c.) Sh., 2–3 ; large mauve-violet fl's. ; found on rocks. Very showy.
Chonemorpha macrophylla. Bulu-walanguna. *Apocynaceae.* Large woody twiner, with large leaves. Fl's. large, creamy-white, scented.
Clematis smilacifolia. Narawel. *Ranunculaceae.* (L.c.) Cl. Small, white fl's. L. ovate, 7-nerved.
Clerodendron serratum. Ken-henda. (L.c.) Sh., 4–8 ; fl's. bright blue. A handsome sh. ; also indigenous to India, Malaya, etc.
Clitoria ternatea. Nil-katarodu. (L.c.) Ann. cr., 8–10 ; fl's. bright blue.
Coleus barbatus. Wal-kapura-walliya. (L.c., rocky ground.) $1\frac{1}{2}$–2. Fl's. rich purple, in whorls. **C. inflatus.** (U.c. moist jungle.) 2–4. L. large, oval ; fl's. pinkish-violet. Aug.-Jan. Endemic.
Costus speciosus. Tebu. (L.c.) Hp., 5–6 ; fl's. white and yellow.
Crossandra undulaefolia. *Acanthaceae.* Dry region. (L.c.) Sh., 2 ; fl's. bright salmon-yellow, ornamental.
Crotalaria Walkeri. *Leguminosae.* (U.c.) Sh., 4–6 ; fl's. striated yellow.

Curculigo recurvata. Waga-pol. *Amaryllideae.* (L.c.) Hp., 2–3 ; stemless plant with large palm-like, plicate, arching lvs. See *Fol. Pot Plants.*
Cyanotis obtusa. *Commelinaceae.* (L.c.) Hp., 1 ; fl's. violet-blue.
Cycas circinalis. Madu. *Cycadeae.* (L.c.) T., 10–15 ; palm-like pinnate lvs.
Cynoglossum micranthum. *Boragineae.* (U.c.) Hp., 2–3 ; fl's. deep blue.
Cyphostigma pulchellum. *Scitamineae.* (L.c.) Hp., $\frac{1}{2}$–1 ; fl's. bright pale pink.
Daedalacanthus montanus. *Acanthaceae.* (I.e.) Sh., 2–3 ; fl's. pale violet-blue.
Datura suaveolens. Rata-attana. *Solanaceae.* (U.c.) Sh., 2–3 ; fl's. large, white.
Dianella ensifolia. *Liliaceae.* (I.e.) Hp., 3–5 ; fl's. pale-blue, followed by pretty blue berries. Narrow grass-like lvs.
Didymocarpus zeylanicus. *Gesneraceae.* (U.c.) Hp., $\frac{1}{2}$; white and purple.
Exacum macranthum. (U.c. open patanas.) See p. 190, etc.
Filicium decipiens. Pehimbiya. (L.c.) See *Orn. Fol. Trees.*
Gloriosa superba. (L.c.) See *Flowering Climbers,* etc.
Glossocarya scandens. *Verbenaceae.* Dry region. W. cl. or sh. Fl's. white.
Gymnostachyum zeylanicum. *Acanthaceae.* (L.c.) Hp. $\frac{1}{2}$. L. variegated with creamy-white veins.
Hibiscus angulosus, var. grandiflorus. *Malvaceae.* (U.c.) Hp., 5–6 ; fl's. large, bright yellow with brown centre.
Humboldtia laurifolia. Gal-karanda. (L.c.) Sh. or tr. See *Flowering Shrubs.*
Hypericum mysorense. *Hypericaceae.* (U.c.) Sh., 5–8 ; fl's. bright yellow.
Impatiens acaulis. *Geraniaceae.* (U.c.) Hp., 1 ; fl's. bright rosy pink. **I. elongata.** (U.c.) Hp., 2 ; whole plant tinged with red, fl's. bright rose pink. **I. flaccida.** Kudalu-mal. (L.c.) Ann., 2 ; mauve and pink ; also a white var. **I. hookeriana.** (U.c.) Hp., 3–5 ; fl's. large, white, streaked with red. **I. repens.** Gal-demata. (L.c.) H. cr. ; fl's. bright yellow ; stems purplish-crimson. **I. Walkeri.** (U.c.) H., 2–3 ; fl's. scarlet, sometimes yellow.
Ipomoea Bona-nox. Alanga. Moon-flower. Woody cl. ; large white fl's., opening at dusk. **I. palmata.** Woody cl. L. palmately cut ; fl's. dull violet-purple. **I. vitifolia.** L. much cut.
Ixora coccinea. (L.c.) *Rubiaceae.* Sh., 4–6 ; fl's. scarlet, very showy. **I. jucunda.** (L.c.) Sh., 10–12 ; fl's. bright coral red.
Jussieua suffruticosa. *Onagraceae.* (L.c.) Hp., 4–6 ; fl's. yellow.
Justicia Betonica. Sudu-puruk. *Acanthaceae.* (L.c.) Sh., 4–5 ; pale violet.
Kendrickia Walkeri. *Melastomaceae.* (U.c.) Ep. sh. Fl's. bright rose ; showy.
Klugia notoniana. Dyanilla. *Gesneraceae.* (U.c.) Ann., 1 ; fl's. deep blue.
Lawsonia alba. Tree Mignonette. (Dry region.) See *Dyes.*
Leonotis nepetaefolia. Maha-yak-wanassa, *S* ; Kasi-tumpai, *T.* *Labiatae.* (L.c.) Herb. sh., 4–5 ft., quadrangular stems. Fl's. orange-scarlet. Showy
Melastoma malabathricum. Maha-bowitiya. (L.c.) Sh., 6–10 ; fl's. violet-mauve.
Memecylon umbellatum. Kora-kaha. (L.c.) See p. 108.
Mundulea suberosa. Wal-burutu. *Leguminosae.* (Dry region.) Sh. or tr., 10–15 ; fl's. bright pinkish-violet.
Nepenthes distillatoria. Pitcher Plant. (L.c.) See *Insectivorous Plants.*
Ophioglossum pendulum. Ribbon Fern. See *Ferns.*
Osbeckia buxifolia. *Melastomaceae.* (U.c.) Sh., 4–6 ; fl's. rich mauve. **O. rubicunda.** Bowitiya. (U.c.) Sh., 4–6 ; fl's. brilliant purplish-crimson, with large yellow anthers. A beautiful sh., always in flower ; common on banks or in poor rocky soil.
Oxystelma esculentum. Kulappalai, *T.* *Asclepiadaceae.* Dry region. Herb. cr. Semi-aquatic ; fl's. cup-shaped, veined with pink.
Pavetta indica. *Rubiaceae.* (U.c.) Sh., 4–6 ; fl's. white, in bunches, profuse.
Phyllanthus myrtifolius. Ceylon Myrtle. (L.c.) See *Orn. Fol. Shrubs.*
Plumbago zeylanica. Ela-nitul. (L.c.) Sh., 2–3 ; fl's. white.
Rhaphidophora decursiva. See p. 126.
Rivea ornata. Muchuddai, *T.* *Convolvulaceae.* (Dry region.) Cr. on rocks. Fl's. Dec.–March, pure white to yellow, sweet-scented.
Sansevieria zeylanica. Niyanda. (L.c. and dry region.) See *Fibres.*
Sonerilla Gardneri. *Melastomaceae.* Endemic, rare. (U.c.) Herb. $1–1\frac{1}{2}$ ft. L. 5–7, nerved ; fl's. pink ; rare. **S. hirsutala.** (U.c.) 2 ft. or more ; fl's. large, pale pink. Endemic.
Sophora tomentosa. Mudu-murunga. (L.c.) See *Fol. Shrubs.* **S. violacea.** (L.c.) Sh., 3–4 ; fl's. violet.

Stachytarpheta mutabilis. Balunakuta. *Verbenaceae.* Hp., 3–4; fl's. pink, on long, scaly spike.
Strobilanthes helicoides. (U.c.) 3–5; fl's. violet with white tube; ornamental. **S. asperrimus.** (U.c.) Sh.; fl's. pale purple, tinged with pink. Resembles Hop. **S. Hookeri.** (U.c.) Sh., 2–4; fl's. pure white, purple veins. **S. pulcherrimus.** (U.c.) Sh., 3–6; fl's. bright pink and violet. Showy.
Tephrosia maxima. *Leguminosae.* (Dry region.) Hp., 1–2; fl's. bright pale pink.
Thespesia macrophylla (= T. Lampas). *Malvaceae.* (Dry region.) Sh., 6–8; fl's. bright yellow, dark crimson centre. Apparently rare.
Torenia asiatica. Kotala-wel. *Scrophulariaceae.* (U.c.) H. cr.; fl's. dark purple, tube pale yellow.
Vaccinium Leschenaultii. Boralu. *Vacciniaceae.* (U.c.) Sh. or tr., 8–12; fl's. bright pink; season Feb.–March, also Sept.
Woodfordia floribunda. Malitta. *Lythraceae.* (I.) Sh., 6–8; fl's. orange-red.
Wrightia zeylanica. (L.c.) In sandy soil near the sea. See *Flowering Shrubs*.

CHAPTER XIII

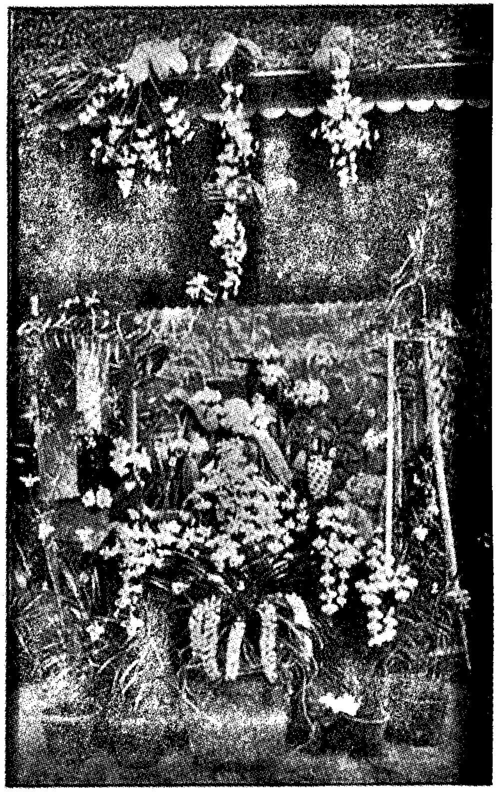
ORCHIDS, POT-PLANTS, AND FERNS

SUITED TO LOW AND MEDIUM ELEVATIONS

(1) *ORCHIDS.* (2) *SELECTED CEYLON ORCHIDS.* (3) *FOLIAGE POT-PLANTS.* (4) *FLOWERING POT-PLANTS.* (5) *FERNS FOR POTS, FERNERIES, ETC.*

Orchids may be divided into two main classes, (1) *terrestrial* or ground orchids, and (2) *epiphytes*. The latter term indicates plants which grow naturally on trees but do not derive nourishment from their host, *i.e.* not parasitic. The great majority of tropical orchids belong to this class, whereas most of the temperate forms are terrestrial, or growing on the ground. *Saprophytic* orchids, which live on dead matter, are rare.

In order to grow orchids successfully, a knowledge of the conditions of the climate, etc., under which they grow in their natural state is helpful, if not indispensable. Those belonging to a dry region often fail to thrive when removed to a wet climate, and *vice versa*; thus Cattleyas and other S. American species, which are accustomed to a long dry period, soon deteriorate in the moist climate of the south-west part of Ceylon, especially if not protected during long rainy seasons. Nevertheless, orchids, like other plants, are often adapt-



Group of Orchids in Ceylon.

1 and 5, *Phalaenopsis schilleriana*; 2, *Cattleya sanderiana*; 3, *Rhyncostylis retusa*; 4, *Renanthera* (*Arachnanthe*) *Maingayi*; 6, *Dendrobium thyrsiflorum.*

able to altered conditions. Epiphytic species generally thrive better on trees than in pots, but the former conditions cannot always be provided, and for various reasons pot-culture is usually the most convenient to adopt. Many orchids thrive best when fully exposed to the sun, provided sufficient moisture is available at the roots; others, however, grow and flower best under light shade.

Potting Orchids.—Special kinds of pots with several drainage holes and perforated sides are made for growing orchids in. Useful substitutes, however, may be found in well-seasoned joints of large bamboos, these being cut so as to leave one of the divisions intact, this being perforated at the bottom and sides. Another useful type of bamboo-pot for orchids is afforded by a longitudinal section of the joint, with one side cut away slantingly; thin copper wire is strung through the margins to hold the plant and potting material in position, a layer of coir fibre or beaten coconut husk being placed between the material and the wires. For epiphytes, a potting mixture consisting of old bark, broken crocks or pieces of porous brick and some sphagnum moss (*Sphagnum zeylanicum*) is essential. Peat and sphagnum in equal proportions form a safe compost for nearly all orchids, but the former is not procurable in Ceylon, and the latter is difficult to obtain, being only found in a limited area on Horton Plains. Chopped up bracken or other fern roots are a useful ingredient in orchid composts, and are generally easily obtained. Well-leached coir fibre or coconut husks form a very serviceable material much employed in the Botanic Gardens of Ceylon for growing orchids of all kinds, and is indispensable for fixing them on boards, stems of trees, etc. For terrestrial or ground orchids, a compost of loam, well-decomposed cattle manure, ½ in. bones, broken pieces of old bark and knobs of charcoal is suitable. Many, as Phaius, Calanthe, etc., will thrive in loam and leaf-mould.

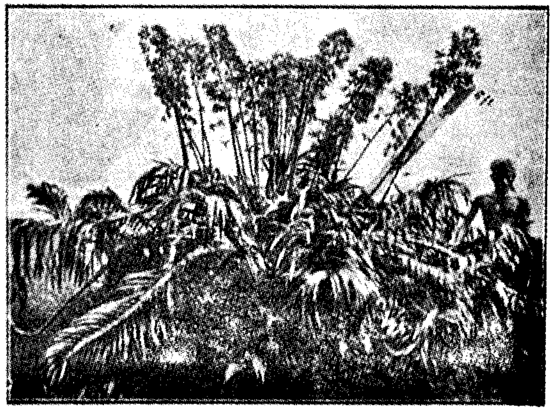
Coelogyne odorata.
Flowers sweet-scented.

Propagation of Orchids.—Orchids are usually propagated or increased by means of cuttings or divisions of the root-stock or pseudo-bulbs, being seldom raised from seed, except by expert growers. They are characterised by the presence of a microscopic fungus (*mycorhiza*), mycelium, growing on their young roots and taking the place of root hairs (absent in orchids), whose function it performs by supplying the plant with moisture and food materials through the medium of its hyphae. When orchids are propagated vegetatively, they generally carry with them sufficient of the mycelium for their need, but in raising them from seed it is necessary that the germinating medium be infected with the appropriate fungus. It has been found that in the absence of this, orchid seeds seldom germinate, or that, if they do, the seedlings will not thrive. Therefore the seed should be sown on soil obtained from or permeated with that in which the parent plant grows. In scientific horticulture, pure cultures of these fungi are now made, and when orchid seeds are brought into contact with them in germination their "forcing" effect is remarkable.

The following are among the most showy orchids cultivated at the Royal Botanic Gardens, Peradeniya, Ceylon (elevation 1,540 ft., rainfall about 80 in.). Many others are found growing naturally on trees here, more particularly on old, rough-barked trees with forked branches, such as Mango, Jak, Sapu, etc. Smooth-barked or dense-foliaged trees are usually unsuitable for orchids of any kind.

(Ep. = epiphyte; Terr. = terrestrial.)

Aerides odoratum. India and China. (Ep.) Fl's. scented, white, blotched magenta.
Angraecum sesquipedale. Madagascar. (Ep.) Fl's. very large, ivory-white, long-spurred. **A. modestum,** = **A. sanderianum.** Long sprays of pure white fl's.
Cattleya bowringiana. Cent. Amer. (Ep.) Fl's. bluish-purple and magenta. **C. citrina.** Mexico. Citron-yellow. **C. eldorado.** Cent. Amer. White, purple, and orange shades. **C. gaskelliana.** Venezuela. (Ep.) Fl's. scented, white and amethyst-purple. **C. gigas.** Colombia. (Ep.) Fl's. very large, rose, crimson, purple, and yellow. **C. labiata.** Brazil. (Ep.) Crimson, lilac, etc. **C. Mossiae.** Venezuela. (Ep.) Fl's. large, crimson and rose. **C. Skinneri.** Guatemala. (Ep.) Fl's. rose-purple. **C. Trianae.** Colombia. (Ep.) Fl's. purplish-crimson, very showy.
Chysis bractescens. Peru. (Ep.) Fl's. large, creamy-white; stout fleshy stems.
Coelogyne asperata. Borneo. (Terr.) Fl's. in long drooping racemes, creamy-white, streaked brown, strongly scented. Long pseudo-bulbs, 6–7 in. L. 1½–2 ft. **C. dayana.** Borneo. (Terr.) Long pseudo-bulbs, 4–6 in. L. 2–2½ ft. Fl's. creamy-yellow.
Cymbidium lowianum. Burma. (Ep.) Fl's. large, yellowish-green, with a crimson blotch.
Dendrobium brymerianum. (Ep.) Lip developed into long fringe. **D. Calceolaria.** Very large robust sp. Fl's. large, pale yellow, throat brownish crimson. **D. dalhousieanum.** Burma. Stems 3–5 ft. Fl's. large, tawny-yellow and rose. **D. densiflorum.** India. Fl's. pendulous, amber-yellow and orange. **D. Farmeri.** India and Burma. Yellow, tinted with pink. **D. fimbriatum.** Burma. Fl's. pendulous, rich orange-yellow. **D. Maccarthiae.** "Wesak-mal." Ceylon. Stems slender, 2–2½ ft. Fl's. rose-pink. Difficult of cultivation. Requires hot and moist climate, as in Ratnapura District, Ceylon. **D. nobile.** India and Burma. Fl's. large, showy, white, tipped with rose-purple. Several beautiful var's. **D. pulchellum** (= *D. dalhousieanum*). **D. regium.** Large purplish-blue flowers. **D. superbum.** Philippines, 2–2½ ft. Pink, tinged rose. **D. thyrsiflorum.** Burma. Stems 18–30 in. high. Fl's. in large drooping clusters, white and yellow. **D. wardianum.** Assam. Stems 1–2 ft. Fl's. white, purple and yellow.
Epidendrum radicans. Mexico. (Ep.) Stems long, scandent; fl's. terminal, bright orange-scarlet.
Grammatophyllum speciosum. Giant Orchid. Malaya. (Terr. or ep.) Stems 6–10 ft.; fl's. large, ochre-yellow, blotched with brown; racemes stout, erect, 5–7 ft.
Laelia purpurata. Brazil. (Ep.) Fl's. large, showy, rose-white and crimson-purple.
Laelia-Cattleya Decia. Fl's. large, showy, scented.



GIANT ORCHID (*Grammatophyllum speciosum*).

Lycaste Skinneri. Guatemala. (Terr.) White and crimson.
Oncidium luridum. W. Indies. (Ep.) L. leathery, 1–2 ft. long; fl's. yellow, blotched with brown. **O. Papilio.** Butterfly Orchid. (Ep.) W. Indies. Fl's. large, butterfly-shaped.
Peristeria elata. Holy Ghost Orchid. Panama. (Terr.) L. 2–3½ ft.; fl's. scented, waxy-white, globose; centre part resembles a dove.
Phaius (Thunia) Bensoniae. Moulmein. (Terr.) 2 ft. high, fl's. large, amethyst-purple. **P. Blumei.** Java. (Terr.) Fl's. buff-yellow, mottled with red.
Phalaenopsis amabilis. Malaya. (Ep.) L. broadly oval, 6–12 in. long; fl's. large,

white with red spots. **P. schilleriana.** Philippines. (Ep.) L. 10–18 in. long, blotched with grey. Fl's. large, rose-purple.
Renanthera coccinea. Burma and Indo-China. (Ep. creeper.) Stems 6–10 ft., creeping. Fl's. in long, loose racemes, pink ground, spotted with crimson; very showy. (C.) **R. imschootiana.** Burma. (Ep. creeper.) Height 6–24 ft. Fl's. bright crimson on pink ground. **R. (Arachnanthe) Maingayi.** Burma. Large, robust creeper; fl's. large, pale green, blotched with brown.
Rhyncostylis retusa. Fox-tail Orchid. India, Ceylon, etc. (Ep.) Fl's. white, spotted with amethyst-purple; very showy. See p. 137.

Scorpion Orchid (*Arachnanthe Maingayi*).

Saccolabium guttatum (= **Rhyncostylis retusa**).
Sophronitis grandiflora. Orange-red. Brazil.
Spathoglottis plicata. (Terr.) Borneo, etc. Pink and white var's. Flower spikes 2–3 ft. **S. aurea.** Malaya. Fl's. yellow. Several var's. and other spp.
Stanhopea grandiflora. Ecuador. (Ep.) Fl's. large, fragrant, yellow, shaded with orange and crimson. S. tigrina. Mexico. (Ep.) Fl's. large, scented, crimson, spotted with yellow.
Vanda coerulea. N. India and Assam. (Ep.) Stems 1–3 ft. Fl's. in large sprays, light blue. A beautiful sp. **V. hookeriana.** Malaya. (Ep.) Stem and lvs. cylindrical; fl's. purplish-magenta and orange-yellow. **V. Roxburghii.** Ceylon and Burma. (Ep.) See *Ceylon Orchids*. **V. spathulata.** Ceylon and S. India. (Ep.) Stems several feet long; fl's. large, bright yellow. See p. 142. **V. teres.** India, Burma, etc. (Ep.) Stems and lvs. cylindrical, 2–7 ft. high. Fl's. rose-magenta and orange-yellow. **V. tricolor.** Java. Fl's. yellow, spotted brown, fragrant.

SELECTED CEYLON INDIGENOUS ORCHIDS

Arranged according to region where chiefly found.

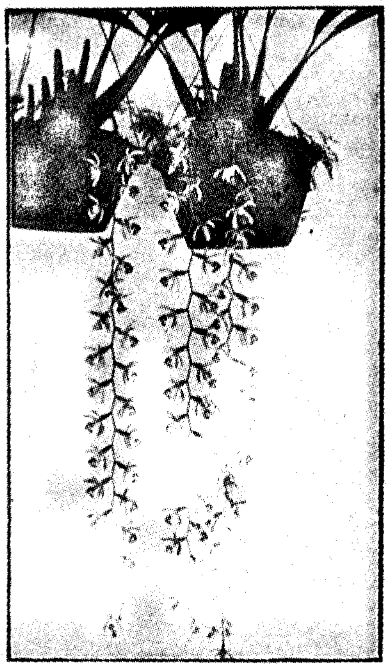
(*A*) *MOIST LOW COUNTRY* (up to about 2,500 ft.)

Acanthophippium bicolor. (Terr.) Fl's. bright yellow, tipped with purplish-red.
Aerides lineare (Saccolabium paniculatum). (Ep.) Fl's. white, tinged pale pink.
Cymbidium bicolor. (Ep.) Fl's. cream-coloured, stained with reddish-purple.
Dendrobium crumenatum. Sudu-pareiyamal. Dove- or Pigeon-Orchid. (Ep.) Often on coconut stems. Fl's. small, pure white. **D. Macarthiae.** Wesak-mal, *S.* (Ep.) Fl's. violet-pink, rarely white. Moist forests below 2,000 ft. Rare; endemic. **D. macrostachyum.** (Ep.) Fl's. pale green or yellow, tinged pink. Up to 4,000 ft.
Eulophia macrostachya. (Terr.) Fl's. purplish-green, lip yellow. **E. sanguinea.** (Terr.) Fl's. dull purplish-red, lip pinkish-green.
Phaius luridus. (Terr.) Fl's. yellow, striped longitudinally with red, lip yellow. Endemic; rare.

Pholidota imbricata. Chain Orchid. (Ep.) Fl's. white, with a pinkish or yellow tinge, in long, drooping racemes.
Saccolabium ochraceum. (Ep.) Fl's. yellow, with red transverse lines. **S. wightianum.** (Ep.) Fl's. pale yellow, tinged with red.
Sarcochilus pulchellus. (Ep.) Fl's. pure white, lip tinged with orange.
Tainia bicornis. (Terr.) Fl's. pale olive-green, stained with purple.

(*B*) *INTERMEDIATE ZONE* (about 2,000–4,000 ft.)

Aerides cylindricum. (Ep.) Creamy-white. Lvs. like *Luisia*. 1,000–4,000 ft.
Anoectochilus regalis. (Terr.) Wana-raja, *S.* Beautiful velvety bronze lvs. Fl's. inconspicuous. Moist shady forests, among decayed lvs. See p. 143.
Arundina bambusifolia. (Terr.) Large, leafy, reed-like stems, 5–7 ft.; fl's. pink.
Cottonia macrostachya. (Ep.) Fl's. yellowish-green, veined with pink, resembling an insect. Rare.
Geodorum dilatatum. (Terr.) Fl's. white, lip suffused with yellow and pink.
Habenaria pterocarpa. (Terr.) Fl's. white, with the spur green. Endemic.
Zeuxine regia. (Terr.) Iru-raja or Sudhu-raja, *S.* Narrow, pointed, velvety-looking lvs., with longitudinal white band in centre. Moist forests.



Chain Orchid (*Pholidota imbricata*).

(*C*) *MONTANE ZONE* (about 4,000–6,000 ft.)

Arundina minor. (Terr.) Fl's. pale pink, lip yellow.
Bulbophyllum elegans. (Ep.) Fl's. dull purple, tinged with green, lip orange.
Calanthe purpurea. (Terr.) Fl's. pale purplish-pink. **C. veratrifolia.** (Terr.) Fl's. pure white, lip pale-pink or dull-yellow.
Chrysoglossum maculatum. (Ep.) Fl's. pale green with reddish blotches, lip white.
Cirrhopetalum grandiflorum. (Ep.) Fl's. yellow, veined and spotted with red; lip purple. Rare.
Cleisostoma tenerum. (Ep.) Fl's. yellow, lip white, with pink wings.
Coelogyne odoratissima. (Ep.) Fl's. white, with a yellow stain on lip, scented.
Cymbidium ensifolium. (Ep.) Fl's. dull yellow, lined with pink; sweet-scented.
Dendrobium aureum. (Ep.) Primrose Orchid. Fl's. pale yellow, sweet-scented.
Eria bicolor. (Ep.) Lily of the Valley Orchid. Fl's. white, on purplish-red stalks.
Ipsea (Pachystoma) speciosa. (Terr.) Daffodil Orchid; Naga-marapu-ala, *S.* Fl's. large, bright yellow. L. narrow or linear, 6–10 in. long. Open patanas; endemic.
Phaius bicolor (= **P. Wallichii**). (Terr.) Fl's. purplish orange, or pale orange-yellow; lvs. large, broad.
Saccolabium roseum. (Ep.) Fl's. pale purple.

(*D*) *DRY OR SEMI-DRY REGION*

Eulophia virens. (Terr.) Fl's. yellowish-green, lip white, with crimson lines.
Habenaria plantagenia. (Terr.) Pigeon Orchid. Fl's. large, pure white.
Rhyncostylis retusa (Saccolabium guttatum). (Ep.) Fox-tail Orchid. Fl's. in long brush-like pendulous racemes; white, dotted violet-pink. Very handsome.

Vanda Roxburghii. (Ep.) Fl's. pale buff or grey, with brown spots and blue lip, scented. Also a var. with pink lip; rare. **V. spathulata.** (Ep.) Fl's. bright yellow, in erect racemes. See p. 140.

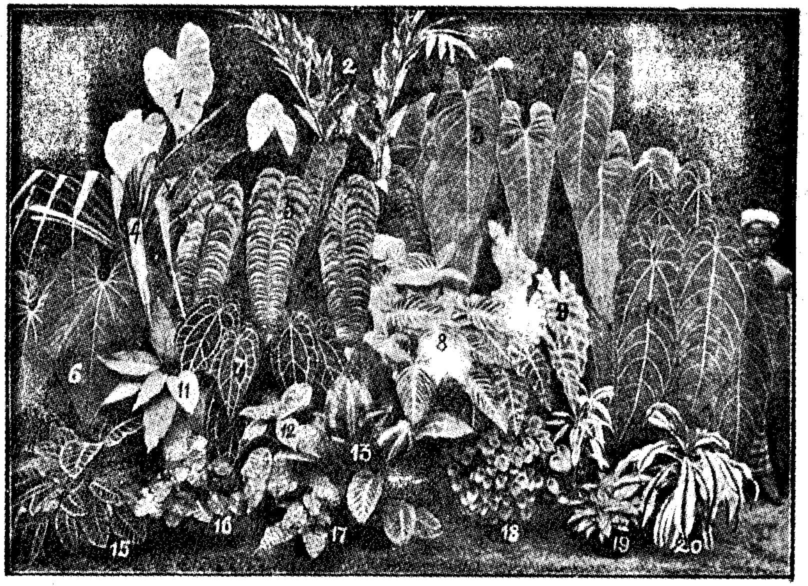
ORNAMENTAL FOLIAGE POT-PLANTS

Suited also for shaded borders up to about 3,000 feet.

For abbreviations, see heading to Chapter XII.

(See also *Ornamental Foliage* and *Flowering Shrubs.*)

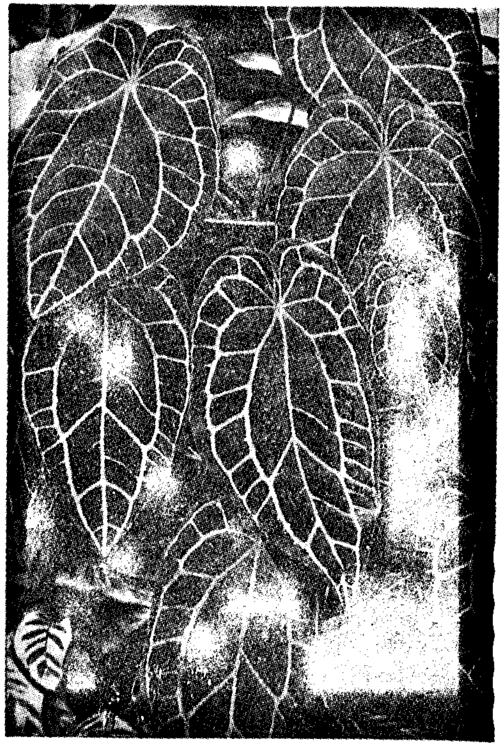
Acalypha godseffiana. New Guinea. 2–3. See *Fol. Shrubs.*
Aechmea fulgens. *Bromeliaceae.* Guiana. 1. Stemless plant with stiff, sheathing lvs. Other spp.: **A. mexicana**; Mexico. 2. **A. Skinneri**; Guatemala. 1½. **A. Weilbachii**; Brazil. 1½. (Off.)



COLLECTION OF ORNAMENTAL FOLIAGE PLANTS.

1, *Nephthytis picturata*; 2, *Alpinia sanderiana*; 3, *Philodendron andreanum*; 4, *Pandanus sanderiana*; 5, *Anthurium Veitchii*; 6, *Anthurium macrolobum*; 7, *Anthurium crystallinum*; 8, *Phyllotaenium Lindeni*; 9, *Alocasia Sanderi*; 10, *Anthurium warocqueanum*; 11, *Schismatoglottis decora*; 12, *Dracaena goldieana*; 13, *Calathea Veitchii*; 14, *Dracaena sanderiana*; 15, *Maranta zebrina*; 16, *Dichorisandra undata*; 17, *Cryptanthus undulatus zebrinus*; 18, *Peperomia Saundersii*; 19, *Aglaonema costatum*; 20, *Dracaena Victoriae.*

Aglaonema costatum. *Aroideae.* Perak. ½; fleshy, variegated or blotched leaves. Other species: **A. Haenkii**; Philippines. 2. **A. marantifolium**; Malaya. 2. **A. pictum**; Malaya. 1–2. **A. versicolor.** 1½–2. (C.)
Alloplectus Lynchii. *Gesneraceae.* Colombia. 1½. L. bronze, purple beneath. (C.)
Aloes. See *Succulent Plants.*
Alocasia argyrea. *Aroideae.* 2. L. peltate, with grey bands. **A. argentea.** L. lobed, silvery grey, 1–1½. **A. cuprea.** Borneo. 1–2. L. peltate, coppery green. **A. eminens**; l. dark green and purple. **A. Johnstoni** (see *Cyrtosperma*). **A. gigantea** (= **A. longiloba**). Malaya. L. very large, deeply cut, narrow lobes. Stem 6–8. **A. Lindeni.** Papua. 1–1½. L. with yellow stalk and veins, broadly arrow-shaped; midrib pale yellow. **A. macrorrhiza variegata.** Ceylon, etc., 4–5. L. very large, cordate, green, with large portions pure white. **A. princeps.** Malaya. 2. **A. Sanderi.** Philippines. 2. L. peltate, scalloped-edges, broad white margins and nerves. See group. **A. thibautiana.** Borneo. 3–4. Silvery white nerves. **A. violacea.** 2. L. metallic blue. **A. zebrina.** Manila. 3. L. deeply sagittate; petiole with dark green bands. Numerous other spp. and var's. (Off., Div. or C.)



SILVER-VEINED ANTHURIUM (*Anthurium crystallinum*).

Alpinia sanderiana. *Scitamineae.* Hort. Leaves streaked and banded with white; very handsome. (Su.) See group opposite.
Ananas sativus variegatus. Variegated Pineapple. *Bromeliaceae.* 1½. L. variegated pinkish-white. (Su.) See *Flower Garden*, etc.
Anoectochilus regalis. Wanaraja, *S. Orchideae.* Ceylon. ½. Velvety bronze lvs., with golden veins. (Tu. or C.) Several other spp. See p. 141.
Anthurium andreanum. *Aroideae.* Colombia. 3–5. Large, handsome, satiny lvs. (C. or Off.) **A. acaule.** Stemless plant. L. very large, oval, 4–5 by 2 ft. **A. bogotense.** Colombia. 2. L. curiously 3-lobed. **A. crassinervium.** Panama. 3–4. L. radical, obovate, upright. **A. crystallinum.** Peru. 2–3. L. large, satiny; prominent silvery veins. See above. **A. digitatum.** Peru. 2–3. L. palmately divided. **A. Fitzeri.** L. large, 4–5, similar to **A. warocqueanum.** **A. Harrisii.** Brazil; and **A. longifolium.** L. strap-shaped, 1½–2. **A. pandulifolium.** Brazil. L. 5–7 ft. long by 6–8 in. broad; very rare. **A. radiatum.** Mexico. 3. L. radially digitate. **A. Veitchii.** Colombia. L. 2½–3 long, furrowed transversely. (Off.) See fig. on p. 142. **A. warocqueanum.** Colombia. L. 3–4 long, satiny green. (Off. or S.)
Aralia Balfouri. Hort. *Araliaceae.* 4–6. L. roundish, wavy, variegated. (C.) **A. elegantissima.** Polynesia. 2–3. L. very finely cut, palmate-digitate; delicate plant, usually prop. by grafting on a more robust sp. **A. filicifolia.** 5–7. Handsome, deeply cut lvs., yellow when young. See p. 113. **A. triloba.** 2–3. L. trilobed. **A. Veitchii.** New Caledonia. 2–3. Finely cut palmate lvs., like **A. elegantissima.**
Arundinaria suberecta. *Gramineae.* 2. Small bamboo-like plant with elegant drooping foliage. (Div.)
Asarum geophyllum. *Aristolochiaceae.* China. ½. L. circular, variegated. (Div.)
Asparagus myriocladus. Natal. L. (cladodes) in small, fine, brush-like whorls. 1–1½. **A. plumosus** and other spp. See *Orn. Fol. Climbers.*
Begonia albo-picta. *Begoniaceae.* Brazil. 1½. L. spotted white. **B. gogoensis.** Sumatra. 1. L. peltate. **B. grandis.** 1–2. L. satiny, with pale spots. **B. haageana.** Brazil. 3. **B. heraclifolia.** Mexico; 3. L. bronzy-purple. **B. purpurea.** 2. L. satiny, deep bronzy-purple. **B. rex.** Numerous var's. 1.

Anthurium pandulifolium.
Leaves 5 to 7 feet long. Rare.

L. variously and beautifully marked. **B. sceptrum.** Brazil. 3–4. L. spotted grey. **B. tomentosa.** Brazil. 1½–2. L. greyish tomentose. (C.) Numerous other spp. and var's. See pp. 127, 183, etc.

Bertolonia marmorata. *Melastomaceae.* Brazil. ½–1. Beautiful, shade-loving, delicate plants; young lvs. purplish-crimson with a satiny sheen. **B. superba.** Madagascar. 1. L. 5-nerved, beautifully marked, like above. (C.)

Billbergia rosea. *Bromeliaceae.* Trop. Amer. 2–3. L. erect, rigid convolute, banded and blotched with grey and bronze; fl's. rose-pink on long spike. **B. sanderiana.** Brazil. 1½. **B. thyrsoidea.** See p. 148.

Bowenia spectabilis. *Cycadeae.* Queensland. 2–3. Large, bipinnate, fern-like lvs. (Su. or S.)

Caladium. See *Bulbous and Tuberous Plants.*

Calathea arrecta. *Scitamineae.* Ecuador. 3. L. erect, tinted bronze. **C. grandiflora.** Brazil. 2. Large round lvs. **C. Leitzii.** Brazil. 1½. Erect habit. L. small, with dark grey bands. **C. lindeniana.** Peru. 2–3. L. beautifully marked on both sides. **C. sanderiana.** Brazil. 1. L. with transverse parallel pink lines. **C. makoyana.** Trop. Amer. ½. L. with oval or round dark blotches. **C. medeo-picta.** Brazil. 1½. L. with white, feathery, central stripes. **C. tigrina.** L. with distinct alternate bands of light and dark-green. Similar to, but distinct from, **C. zebrina. C. Veitchii.** Bolivia. 2–3. L. large, oblong, with 3 longitudinal bands of dark green above, and corresponding broad purple bands beneath. **C. veitchiana.** Brazil. 1. L. broadly oval or round, variegated; purple beneath. **C. zebrina** (= **Maranta zebrina**). Zebra Plant. Brazil. 2–3. L. velvety, with parallel bands of light and dark-green; similar to **C. tigrina,** but with darker green and less distinct bands. (Div.) See fig. on p. 142.

Caraguata andreana. *Bromeliaceae.* Colombia. 2. Stiff convolute lvs., prettily marked. **C. musaica.** Colombia. 1. **C. Zahnii.** Chirqui. L. prettily marked. (Off.)

Carludovica palmata. Panama-hat Plant. See *Fibres.* **C. Plumerii.** S. Amer. 6–7. Similar to above. (Su. or S.)

Centradenia rosea. *Melastomaceae.* Mexico. Pinkish purple lvs. (C. or Div.)

Chamaeranthemum argenteum. *Acanthaceae.* New Britain. 1½–2. L. variegated. **C. pictum.** Brazil. 1½. L. with purplish margin and silvery centre. (C.)

Conocephalus suaveolens. *Urticaceae.* Malaya. 4–6. (C.)

Cordyline. Ornamental palm-like plants, with crown of large, crimson, purple, or green lvs. Numerous var's. or spp. See *Orn. Fol. Plants.*

Costus afer. *Scitamineae.* Sierra Leone. 3–4. Fl's. white. Leafy shoots, forming a loop towards apex. **C. elegans.** Costa Rica. 2. L. large, ovate or obovate, velvety, with dark bands. **C. musaicus.** Trop. Amer. 1½–2. L. narrow, margined with grey. **C. pictus.** Mexico. 4–5. L. satiny-green, glaucous beneath. (Su. or Div.)

Cryptanthus Beuckeri. *Bromeliaceae.* Brazil. ½. L. rigid, in rosette, prettily marked. **C. undulatus var. zebrinus.** Brazil. ½. L. with transverse bands of brown. (Off.)

Curculigo recurvata. See *Ceylon Plants.* Also a variegated form.

Cycas circinalis. Madu, *S.* **C. revoluta.** China and Japan. **3–4.** **Dwarf elegant** species. See *Fol. Shrubs.*

Cyclanthus cristatus. See *Fol. Shrubs.*

Cyperus alternifolius. Umbrella Plant. Radiating narrow lvs. in umbels. Also a variegated form. **C. elegans.** 1–1½. Similar to preceding sp., but smaller. **C. Papyrus.** Papyrus Grass. See *Orn. Grasses and Sedges.*

Cyrtosperma (Alocasia) Johnstoni. *Aroideae.* Solomon Islands. **4–6.** **Large,** arrow-shaped reddish lvs.; petioles mottled, spiny. (Su. or Off.)

Dichorisandra mosaica. *Commelinaceae.* Peru. ½. L. variegated, mosaic-like. **D. thyrsiflora.** Brazil. See *Flowering Pot Plants.* **D. undata.** Peru. ½. L. oval, undulated, striped grey along 8 nerves. **D. vittata.** Hort. ½. L. purplish-green, with grey stripes along nerves. (C.)

Dieffenbachia Bowmani and other spp. or var's. Dumb-cane. *Aroideae.* Brazil. 2–5. Ornamental, quick-growing, fleshy herbaceous plants; variegated and blotched with grey or creamy-white. See *Poisonous Plants.* **D. magnifica.** Venezuela. **D. Memoria-Cortii;** Hort. **D. picta;** Brazil. **D. warocqueanum.** Petioles white; blade with few pale spots; distinct. Several other spp. and var's. (C.)

DUMB-CANE (*Dieffenbachia Bowmani*).
Contact of freshly cut stem with the tongue causes temporary dumbness.

Dorstenia argentata. *Urticaceae.* Brazil. 1. Lvs. with central silvery band. (Div.)

Dracaena godseffiana. *Liliaceae.* See *Cordyline.* 3–4. Branching, woody shrub, with small variegated lvs. **D. goldieana.** 2–5. L. broadly oval, regularly marked with dark spots and patches. **D. sanderiana.** 2–4 or more. Erect. Narrow green lvs. with creamy-white margins. **D. Victoriae.** 2–4. L. long narrow, creamy-white, with green stripe in centre. (C. of stem or S.) All of W. Trop. Africa. See fig. on p. 142.

Dracontium (Godwinia) gigas. See *Bulbous and Tuberous Plants.*

Episcia cupreata. *Gesneraceae.* Nicaragua. Hp. 1½. Bronze-coloured lvs. **E. (Centrosolenia) tessellata.** Peru. 1½. L. oval, bronze, hairy, strongly bullate, purplish-crimson beneath. (C.)

Eranthemum atropurpureum. 4–6. Sh. L. variegated bronze or purple. Several var's., as **E. tricolor, E. versicolor,** etc. (C.)

Fittonia argyroneura. *Acanthaceae.* Peru. ½. L. oval, white net-veins. (C.) **F. gigantea.** Ecuador. 1½. L. oval, reddish, with pink net-veins.

Heliconia aureo-striata (= **H. Bihai**). *Scitamineae.* New Britain, etc. 4–6. Large, handsome, broad lvs., striated with yellowish, almost transverse lines. **H. illustris.** Hort. 4–6. L. coppery, striated with bright pink lines. **H. insigne.** 5–6. Leaves bright bronze, long, narrow and wavy. (Su.)

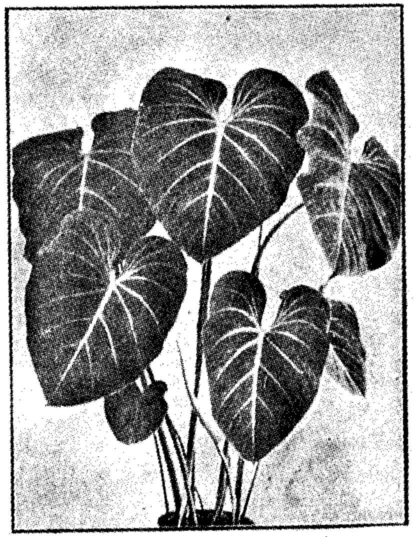
Hoffmannia discolor. *Rubiaceae.* Mexico. ½. L. satiny-bronze. **H. (Higginsia) Ghiesbreghtii.** Mexico. 1½–2. L. obovate, satiny-brown; nerves deeply sunk (rugose); crimson beneath, midrib grey. **H. (Higginsia) refulgens.** S. Amer. 1–2. L. deep bronze. (C.)

Homalomena picturata. *Aroideae.* Colombia. 1. L. variegated. **H. pubescens.** Trop. Amer. 4. L. large, handsome, peltate, tomentose beneath. **H. Wallisii.** Colombia. 1. L. large, thick, variegated grey and green. (Off.)

Jacaranda filicifolia and **J. mimosaefolia.** Ornamental fern-like foliage in young state. (C. or S.) See *Flowering Trees.*

Kaempferia Gilberti. *Scitamineae.* Burma. ½. L. with white bands. (Div.)

Kalanchoe flammea. Life Plant. *Crassulaceae.* Somaliland. 1–1½. L. succulent, deeply cut; fl's. in large, crimson panicles. (C.)
Karatus cruenta. *Bromeliaceae.* Brazil. 1. Sheathing, rigid lvs., growing in form of bird's nest, tipped bright pink. Several spp., including: **K. Innocentii striata. K. spectabilis.** 1–1½. Fl's. in squat head, in centre. (Su. or S.)
Ledenbergia roseo-aena. *Phytolaccaceae.* Cent. Amer. 1–2. L. coppery-green, purple underneath. (C.)
Leea amabilis var. splendens. *Ampelideae.* 3–4. Handsome, pinnate, bronzy-green lvs., creamy-white or pink along midrib. (C.)
Ludovia crenifolia. Palm-like stemless plant. See *Water Plants.*
Macrozamia Fraseri, M. Moorei and other spp. See *Fol. Shrubs.*
Maranta. *Scitamineae.* Chiefly Trop. Amer. Stemless plants with large, beautifully marked lvs., similar to Calathea. **M. imperialis.** 2–3. **M. insignis.** 1. **M. Lubbersii.** 2–3. L. mottled grey. **M. makoyana.** ½. Small oval lvs. with brown patches. **M. Massangeanum.** ½; oval lvs., with brown oval spots. **M. picta; M. politia.** 1. **M. sangoreana.** Hort. 1½. **M. tigrina** and **M. zebrina.** (Div.) See *Calathea.* Lvs. of Maranta and Calathea close towards the centre on approach of night.
Nephthytis picturata. *Aroideae.* Congo. 1½. L. large, handsomely marked with pale green and dark satiny bands. (Su.)
Ophiopogon japonicus. Japan. ½. **O. j. variegata**; lvs. variegated, grass-like.
Oxalis bupleurifolia. *Geraniaceae.* Brazil. 1–1½. Petioles flattened like lvs. (C.)
Palisota Elizabethae. *Commelinaceae.* Congo. 1. Long radical lvs. with broad silvery band along centre.
Panax crispum. *Araliaceae.* Brazil. 2–3. L. much cut. **P. elegans.** Australia. 2–3. L. bipinnate. **P. multifidum.** 1–1½. L. very finely cut, resembling parsley. **P. Victoriae.** 2–3. L. pinnate; leaflets deeply dentate, with white margins. (C.)
Pandanophyllum (Mapania) Wendlandii. *Cyperaceae.* 2–3. Grass-like plant.
Pandanus sanderiana. Variegated Screw-pine. Handsome foliage. L. pale yellow, with broad streaks of green. **P. Veitchii.** Polynesia. 2–3. Like the above but not so robust. See p. 142.
Panicum plicatum. *Gramineae.* 3–4. Long, broad, plicate lvs. See *Orn. Grasses.*
Peliosanthes Teta. *Haemodoraceae.* India. 1. Plicate radical lvs. (Div. or S.)
Pellionia deveauana and **P. pulchra.** *Urticaceae.* Cochin China. Small, trailing, fleshy stems and lvs., blotched grey and green. (C.)
Peperomia argyreia. *Piperaceae.* S. Amer. 12 in. Succulent, variegated, oval or round, peltate lvs. (Div.) Other spp.: **P. Fraseri; P. magnifica,** Hort. 2–3. **P. Saundersii;** Brazil. 1. L. blotched or lined with grey bands.
Phalaris arundinacea variegata. *Gramineae.* See *Orn. Grasses.*
Philodendron andreanum. Large, satiny, pointed lvs. **P. gloriosum.** Large, handsome, broadly cordate-hastate lvs. with pinkish-white nerves. **P. Mamei.** L. very large, broadly cordate, blotched and mottled with grey. **P. Selloum.** L. bipinnatifid. A handsome species. **P. squamiferum.** L. 5-lobed, satiny-green, shaded with dark green; petioles with reddish bristles. All of Trop. S. Amer. and prop. by (C.).
Phrynium variegatum. See p. 129.
Phyllanthus nivosus. *Euphorbiaceae.* Polynesia. 2–5. Slow-growing. L. small, mottled pinkish-white. (C.)
Phyllotaenium (Xanthosoma) Lindeni *Aroideae.* Colombia. 1–1½. Large handsome sagittate lvs., with broad white bands. (Su.) See fig. on p. 142.



Philodendron gloriosum.

Pilea muscosa (= **P. microphylla**). Artillery Plant (referring to the opening of the inflorescence). *Urticaceae.* Trop. Amer., nat. in Ceylon. Dwarf, evergreen, moss-like plant; good for edgings, rockeries, etc. (C.)
Pothos. See *Ornamental Climbers.*
Rhoeo discolor. *Commelinaceae.* Cent. Amer. 1–2. Fleshy plant; lvs. bronzy-purple, underside bright purple. (C.)
Ruellia colorata. *Acanthaceae.* Moluccas. ½. Creeping; purplish-bronze. (C.)
Sansevieria cylindrica. See *Fibres.* **S. guineensis.** L. fleshy, erect, sword-shaped. **S. Laurentii.** Similar to latter, but lvs. are white-margined.
Schismatoglottis decora. *Aroideae.* Borneo. ½. L. lanceolate, variegated. (Div.) **S. neoguineensis.** New Guinea. 1. L. large, oval, blotched with grey. **S. picta.** Java. 1. L. dark green, 2 grey bands. **S. siamensis.** Siam. 1. L. lanceolate, spotted grey. (Div.)
Schizocasia (Alocasia) Portei. *Aroideae.* New Guinea. Stem 5–8. L. very large, deeply bipinnatifid, sagittate. (Su.) See fig. opposite.
Stangeria paradoxa. *Cycadeae.* Natal. 3. Handsome fern-like plant. (Off.)
Stenandrium Lindeni. *Acanthaceae.* Brazil. 1. Handsome variegated lvs. (C.)
Steudnera colocasiaefolia. *Aroideae.* Martaban. 2. L. oval, peltate. (Su.) **S. discolor.** India. 2. L. peltate, with dark, oblong, radiating blotches above, purple beneath.
Strobilanthes dyerianus. *Acanthaceae.* Burma. 2–3. Young lvs. satiny-crimson and purple; requires shade. (C.)
Tillandsia pulchella. *Bromeliaceae.* Brazil. 1. Epiphyte; ornamental-coloured leaves. Fl's. bright pink. (Su.) **T. splendens** (= **T. zebrina**). Guiana. 1. L. with transverse violet bands.
Tradescantia fuscata. *Commelinaceae.* Brazil. ½. L. covered with reddish hairs. **T. zebrina** (= *Zebrina pendula*). **T. Reginae.** Hort. 1. L. mottled white, with violet centre. (C.)
Typhonodorum lindleyanum. *Aroideae.* Giant Arum. Stem stout, 5–6 ft. by 15 in. diam.; lvs. very large, hastate, 5–6 ft. (S. or Su.)

Schizocasia (Alocasia) Portei.
Showing curious succulent leaves.

Xanthosoma Lindeni. See *Phyllotaenium.* Several other spp.
Zamioculcas Loddigesii. *Aroideae.* Trop. Africa. L. pinnate, 3–4 ft. long. (Div.)
Zebrina pendula. *Commelinaceae.* Mexico. Small herb. creeper; drooping ornamental foliage. L. with grey and purple bands, purple beneath. (C.)
Zeuxine regia. Iru-raja. *Orchideae.* ½. See p. 141.
Zingiber Darceyi. Variegated Ginger. *Scitamineae.* 2. L. variegated. (Tu.)

FLOWERING POT-PLANTS

Suitable for shaded borders up to 4,000 ft.

(See also *Up-Country Plants.*)

Acalypha sanderiana. *Euphorbiaceae.* Papua. 4–5. Fl's. in long crimson, drooping tails (catkins). (C.) See fig. on p. 102.
Achimenes. See *Bulbous Plants.*

Aechmea fulgens. *Bromeliaceae.* Guiana. 2½. Rich crimson and pink. (Off.) **A. paniculigera.** W. Indies. 1–2. Rose-coloured. **A. spectabilis.** Guatemala.

Aeschynanthus Hildebrandii. *Gesneraceae.* Burma. Small epiphytic cr.; scarlet fl's., tipped dark-brown. (C.)

Amydrium humile. *Aroideae.* Borneo. ½. White. Div.)

Anthurium "Archduke Joseph." Hort. *Aroideae.* 2. Bright rose. (Off. or S.) **A. carneum.** Hort. Light rose colour. **A. chelsiense.** Hort. 1½. Crimson. **A. desmetianum.** Crimson-scarlet. **A. ferrierense.** Hort. Spathe bright red. **A. scherzerianum.** Guatemala. 1–2. Spathe large, scarlet or crimson, etc.; spadix spiral, brightly coloured. (Off. or S.) Several var's.

Aphelandra nitens. *Acanthaceae.* Colombia. 1½. L. shiny, dark-green; fl's. scarlet. (C.)

Billbergia thyrsoidea. *Bromeliaceae.* Brazil. 1–1½. Stemless plant. Fl's. scarlet and violet, on erect head. L. broad at base, narrowed upwards. See fig. opposite.

Centropogon lucyanus. Hort. *Campanulaceae.* 1½. Crimson, tubular fl's. (C.)

Cochliostema jacobianum. *Commelinaceae.* Ecuador. 1½. Fl's. in large, loose clusters, blue and pink. Very showy. (Div.)

1, *Billbergia thyrsoidea.* Flowers and bracts bright pink.
2, *B. rosea.* Curious convolute and mottled, rigid leaves.

Costus igneus. *Scitamineae.* Brazil. 1–2. Fl's. bright orange; lvs. purple beneath. (Div.)

"African Violet" (*Saintpaulia ionantha*). Deep blue.

Cyanotis barbata. *Commelinaceae.* Nepaul. ½. Fl's. blue. **C. kewensis.** Travancore. ½. Fl's. pink. (Div. or C.)

Dalechampia roezliana. *Euphorbiaceae.* Mexico. 2–3. Rose-coloured bracts. (C.)

Dichorisandra thyrsiflora. Brazil. 3. Bright blue fl's.

Euadenia eminens. *Capparideae.* W. Trop. Africa. 1½. Large, pale yellow fl's. (C.)

Griffinia hyacinthina. *Amaryllideae.* Brazil. 1. Large, beautiful, amethyst-blue fl's. (Div.)

Impatiens flaccida, var. *Geraniaceae.* Ceylon. 1. Pure white. **I. Holstii.** 1. Fl's. salmon-pink. Malaya. **I. mirabilis.** 2–3. Yellow. E. Africa. **I. Sultani.** Zanzibar. 1. Scarlet fl's. (C. or S.)

Isoloma. Numerous var's. Fl's. scarlet, orange, etc.

Karatas Innocentii. *Bromeliaceae.* Brazil. 1. Bright orange-red. **K. spectabilis.** Brazil. 1. Red and violet-blue. (Off.)

Marica borchiana. *Irideae.* Trop. Amer. Fl's. lilac-blue, yellow, and brown; offensive odour. (S. or Su.)

Musa coccinea. Flowering Banana. *Scitamineae.* China. 4–5. Whole inflorescence bright red. (Su.) See fig. on p. 180.

Nematanthus longipes. *Gesneraceae.* Brazil. 2. Scarlet. (C.)

Spathiphyllum Patinii.

Pitcairnea alta. *Bromeliaceae.* W. Indies. 3. Crimson; large loose sprays. **P. coerulea.** Chile. 3. Blue. **P. corallina.** Colombia. 2. Crimson. (Div.)

Saintpaulia ionantha. "African Violet." *Gesneraceae.* Cent. Africa. ½. Purplish-blue fl's.; lvs. hairy, circular or cordate, fleshy. (Leaf-C. or -Div.)

Scutellaria mociniana. *Labiatae.* Mexico. 1½. Scarlet. **S. violacea.** Ceylon, etc. 1. Violet-purple. (S. or Div.)

Sinningia Helleri. *Gesneraceae.* Congo. 1½. Creamy-white. L. variegated. (C.) S. speciosa (*q.v.*).

Siphocampylus elegans. *Campanulaceae.* Colombia. 2. Bright red. **S. tovariensis.** Venezuela. 2. Scarlet. (C.)

Spathiphyllum candidum. *Aroideae.* 1½. White, scented. **S. cannaefolium.** 2. Spathes large, white, scented. **S. Patinii.** Colombia. Pure white; scented. 1½. All of S. Amer. See fig.

Spironema fragrans. *Commelinaceae.* Mexico. 1. White; spiral stamens.

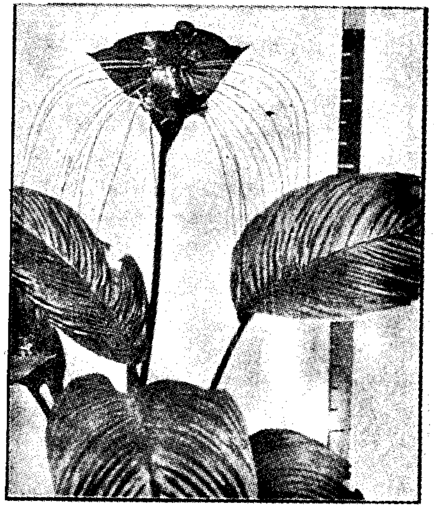
Strelitzia Reginae. Bird of Paradise Flower. 3–4. Large lvs. Fl's. bright orange and purple. (Su.)

Tacca laevis. *Taccaceae.* Trop. Asia. 2. Fl's. brownish-purple, with large bracts and long thread-like filaments. (Div.) **T. pinnatifida;** edible roots (*q.v.*).

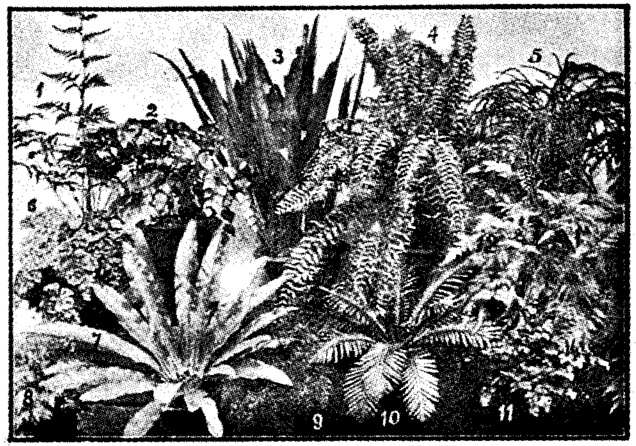
Tillandsia Lindeni. *Bromeliaceae.* 1½. Violet and rose bracts. **T. nitida.** 2. Blue bracts, lvs. convolute. **T. pulchra.** 1. Pink. **T. (Vriesia) recurvifolia.** 2. Blue and rosy-purple. (Div.) All of Trop. Amer. or W. Indies.

FERNS

Ferns comprise an extensive family of plants, and are deservedly popular on account of the beauty and gracefulness of their foliage. Mixed with other plants in the embellishment of verandahs and plant-houses, they are always effective, while in floral decorations their cut fronds lend a special charm. With few exceptions, ferns are not difficult to cultivate; they may be grown in pots, boxes, etc., provided the proper conditions of soil, moisture and temperature are afforded. By observing the conditions under which the plants grow and flourish in their natural state, an accurate idea may be formed of their



Tacca laevis.
Showing thread-like filaments from flowers.



GROUP OF FERNS.

1, *Microlepia platyphylla*; 2, *Adiantum peruvianum*; 3, *Polypodium punctatum*; 4, *Nephrolepis Duffii*; 6, *Adiantum Farleyense*; 7, *Asplenium nidus-avis*; 8, *Selaginella amara*; 9, *Selaginella Vogelii*; 10, *Lomaria gibba*; 11, *Adiantum Fergusoni.*

requirements; it will thus be seen that they usually luxuriate in humous, fibrous soil on limestone rock, occupying shady banks or gullies, as by the side of streams or water-courses.

Therefore it may be accepted as a general rule that their principal requirements are shade, moist atmosphere, shelter from strong wind, and good drainage at the roots. Though generally regarded as shade-loving plants, a striking exception is found in the Gold fern (*Gymnogramme chrysophylla*), which thrives to perfection at sea-level in the full glare of the tropical sun, attaining a large size when grown in tubs along paths or drives. While many species, notably tree-ferns and the finer-leaved Adiantums ("Maidenhair"), thrive best at the higher elevations or under sub-tropical conditions, others are naturally adapted to low elevations. A few thrive in swamps, e.g. *Acrostichum aureum*, which grows naturally on the margins of lagoons.

Gleichenia linearis.

Potting composts for ferns should consist mainly of fibrous loam and leaf-mould

VIEW IN FERNERY, PERADENIYA GARDENS, CEYLON.

Fine specimen of *Rhaphidophora decursiva* creeper on right.

in equal proportions, to which should be added a small proportion of lime or old mortar, and a similar quantity of fine river-sand; broken pieces of porous brick mixed with the soil are also a useful ingredient and have the effect of maintaining proper aeration of the latter. A small portion of old manure may be added in a pulverised state to the compost. Thorough drainage being essential, the pots should be filled to about one-fifth of their depth with crocks. Many of the more delicate ferns, such as Adiantums (Maidenhair), resent their foliage being unnecessarily wetted, especially in dull weather. Ferns are generally easily multiplied by division of the root-stock, or by sowing the brown powder-like spores, usually found on the under side of the fronds. (See **Propagation.**) Some species may be propagated by bulbils produced on the upper side of the fronds, e.g. *Asplenium bulbiferum*. Others, being usually infertile, *e.g.* the "Farleyense," a handsome subcristate variety discovered in Barbados in 1865, have to be propagated almost entirely by root-division. (See *Ferneries.*)

The following are some of the most ornamental ferns suitable for cultivation in the tropics.

RIBBON FERN (*Ophioglossum pendulum*).

FERNS SUITED TO LOW ELEVATIONS

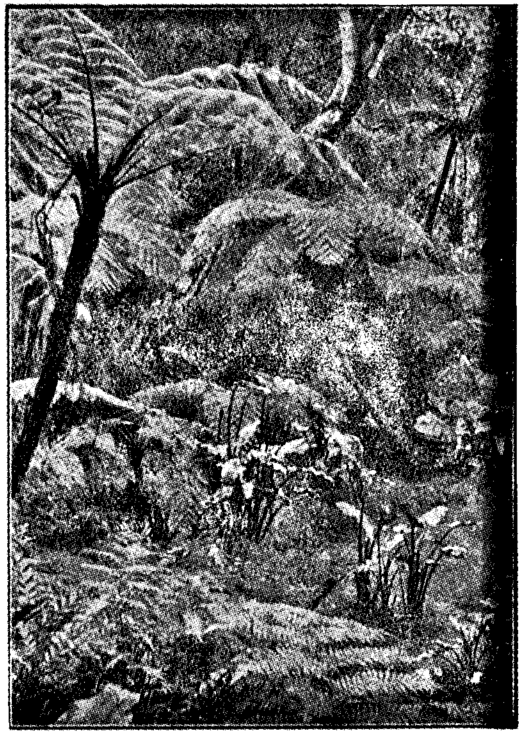
(Those marked * are indigenous to Ceylon)

*Acrostichum aureum. Karang or Kérékoku, *S*; sea-coast, brackish water.
Adiantum concinnum. Maidenhair.
A. cuneatum. Trop. Amer.
A. Fergusoni. Ceylon.
*A. hispidulum. India, Malaya, etc.
A. Pacotti. Chile.
A. peruvianum. Peru.
A. trapeziforme. W. Indies.
A. Weigandii. Hort.
Anemia Phyllitidis. W. Indies.
Asplenium falcatum. India, Malaya, etc.
*A. lunulatum. " "
*A. nidus-avis. Bird's-nest Fern.
*A. sylvaticum. India, Ceylon, etc.
A. tenerum. " "

A. tenerum var. A. Farleyense.
*Blechnum occidentale. W. Indies.
*Cheilanthes tenuifolia.
Davallia fijiensis.
*D. pulchra. India, China, etc.
D. tenuifolia. " "
Dicksonia flaccida. New Hebrides.
Didymochlaena lunulata.
*Gleichenia linearis. Kekilla, *S.*
Gymnogramme chrysophylla. Gold Fern.
G. pulchella. Silver Fern.
G. schizophylla.
Lomaria gibba. Dwarf Tree-fern.
Microlepia (Davallia) platyphylla. India.
Nephrodium exaltata. India, etc.
*N. molle.
N. decurrens.
*Nephrolepis cordifolia.
N. c. var. compacta.
N. davallioides. Java.
*N. Duffii. Australia, etc.
*N. exaltata. Tropics.
N. tripinnatifida. Solomon Islands.
*Ophioglossum pendulum. Ribbon Fern; Patia-dhatu, *S.*
Platycerium alicorne. Elk's Horn Fern.
*Polypodium pustulatum. Australia, etc.
P. quercifolium. Bainduru, *S.* Tropics.
P. verrucosum. Malaya.
Pteris argyraea. Tropics.
P. cretica albo-lineata. Hort.
*P. ensiformis. Trop. Asia.
*P. quadriaurita. Tropics.
P. serrulata. China, etc.

FERN-ALLIES

(Suited chiefly to Low-country)



VIEW IN FERNERY, Hakgala Gardens, Ceylon. *Alsophila crinita* (Tree Fern) in background.

*Azolla pinnata. See *Water Plants.*
*Lycopodium cernuum. Stag-horn-moss; Badalwanassa, *S.*
*L. Phlegmaria. Mahahedaya, *S.*
L. squarrosum. Kudahedaya, *S.*
L. taxifolium. Trop. Amer.
*L. zeylanicum.
*Marsilea quadrifolia. See *Water Plants.*
Selaginella amoena.
S. caulescens. Malaya, etc.
*S. delicatissima. Andes.
S. grandis. Borneo.
S. laevigata. Madagascar.
S. Martensii. Mexico.
S. M. variegata. Hort.
S. uncinata. China.
S. Vogelii. Trop. Africa.
S. Wildenovii. India, Malaya, etc.

FERNS SUITED CHIEFLY TO UP-COUNTRY

*Adiantum Capillus-Veneris. Maidenhair Fern.
A. cuneatum. Trop. Amer.
A. Fergusoni.
A. gracillimum. Finest-leaved Maidenhair Fern.
*Anemia Phyllitidis.
*Angiopteris evecta. Trop. Asia.
*Aspidium aculeatum.

*A. anomalum. See *Polystichum.*
Asplenium bulbiferum. Bears bulbils on fronds.
A. furcatum.
A. lunulatum.
*A. tenuifolium.
*Blechnum orientale.
*Cheilanthes farinosa.
*Davallia bullata.
D. elegans. Trop. Asia, etc.
*D. majuscala.
*Diacalpe aspidioides.
Lomaria Patersoni and L. gibba. Dwarf tree-ferns.
Lygodium scandens. Creeping Fern; fine ornamental foliage.
*Nephrodium flaccida.
*N. Walkerae.
*N. zeylanica.
*Nephrolepis cordifolia.
*Osmunda javanica.
*Polypodium rufescens.
*Polystichum anomalum. Ceylon. Bears spores on upper side of frond.
*P. aristatum.
*Pteris incisa.
*P. quadriaurita. Cluster Fern.
P. sagittifolia. Ivy-leaf Fern. Brazil.
P. Victoriae. Variegated linear frondlets.
*Stenoloma chinensis. Parsley Fern.
Woodwardia japonica. China and Japan.

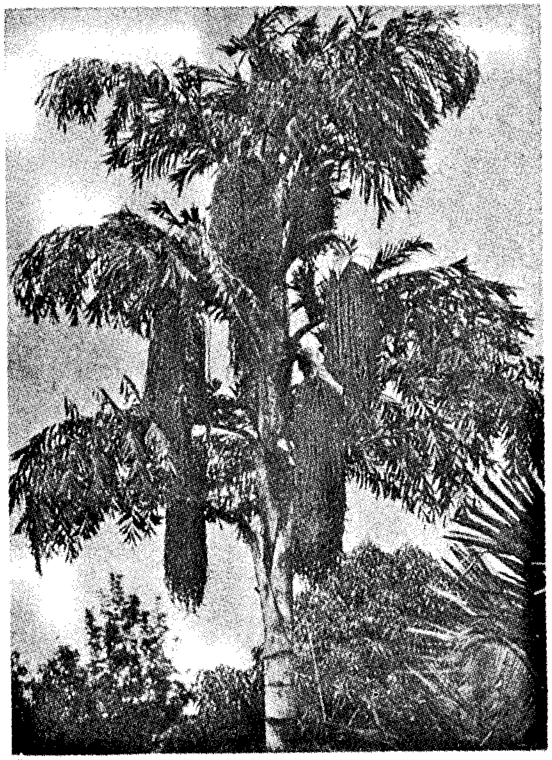
TREE FERNS

*Alsophila crinita. Woolly Tree Fern. Handsome species, 30–40 ft. high, young parts covered with brown fibrous hairs; common from 4,000 to 7,000 ft., in Ceylon.
*A. glabra. India, Malaya, etc.
*Amphicosmia. See *Hemitelia.*
Cyathea dealbata. Silver Tree Fern.
*C. Hookeri. Ceylon, endemic. C. sinuata. Ceylon, endemic.
Dicksonia antarctica.
Hemitelia Walkerae. Ceylon.

CHAPTER XIV

1. *PINNATE OR FEATHER-LEAVED PALMS.*
2. *FAN-LEAVED PALMS.*
3. *SUB-TROPICAL PALMS.*
4. *CEYLON INDIGENOUS PALMS.*
5. *SELECTED CACTI OR SUCCULENT PLANTS.*
6. *ORNAMENTAL GRASSES AND SEDGES.*
7. *BAMBOOS AND BAMBOO-LIKE GRASSES.*
8. *ORNAMENTAL WATER-PLANTS.*

THE large family of palms (*Palmae*) are pre-eminent in the vegetable world for their grandeur, which is especially remarkable in regions where palms grow naturally to their full luxuriance. Linnaeus appropriately styled them "Princes of the vegetable kingdom." There are some 1,150 species of palms known, and more doubtless still remain to be discovered. They may be divided into two main classes: (1) feather- or *pinnate*-leaved, and (2) fan- or *flabelliform*-leaved. About two-thirds of the species come under the former class.



TODDY PALM (*Caryota urens*).
A striking bipinnate palm.

Most palms have upright, straight, unbranched stems, many reaching a great height. Some are bushy, throwing out numerous stems from the base, e.g. *Chrysalidocarpus*, *Ptychosperma*, species of *Licuala*, etc.; while others, as *Chamaedorea*, are dwarf, flowering and fruiting at a height of but a few feet. A few are naturally branched or forked, as the Doum Palm (*Hyphaene*). Some

have bent stems, as the Coconut; others are enormous climbers, e.g. *Calamus* (see "Rattans"). Palms are either wind- or insect-pollinated, or both. Some are dioecious, *e.g.* Date-palm, Palmyra, *Lodoicea* and *Phytelephas*, and others monoecious, as the Coconut and Oil-palm. The following are some of the better known species.

PINNATE-LEAVED PALMS

(Those marked * are best suited to sub-tropical conditions or elevations above 3,000 ft. See also *Ceylon Palms.*)

Acanthophoenix crinita. Mauritius and Reunion. Thorny stems.
Acanthoriza aculeata. Cent. Amer. 30–40 ft. Spiny aerial roots on stem.
Acrocomia sclerocarpa. Gru-gru; Macaw Palm. Trop. Amer. and W. Indies. Stout erect stem, 40–50 ft. Very spiny; spines 3–4 in. long.

1, *Ptychosperma Macarthuri*; 2, *Chrysalidocarpus lutescens.*
Very ornamental, bushy palms.

Actinnorhytis calapparia. Malaya.
Archontophoenix Alexandrae. Queensland. Handsome sp., fl's. in large white panicles. **A. Cunninghami** (= **Seaforthia elegans**). Queensland. 40–50 ft.
Areca Catechu. Areca-nut; Betel-palm. Trop. Asia. See *Masticatories.* **A. concinna.** Ceylon. Small slender stem. See *Ceylon Palms.* **A. triandra.** Assam and Burma. Similar to A. Catechu.
Arenga saccharifera. Gomuti- or Sugar-palm. Java, Sumatra, etc. L. up to 25 ft. or more in length; pinnae 2½–3 ft. by 3 in. broad. Very large, handsome sp. See *Sugar Palms.* **A. Wightii.** Malabar.
Astrocaryum rostratum. Brazil. Petioles very spiny.
Attalea Cohune. Cohune Palm. Honduras. 50–60 ft. Bears very large spadix. **A. excelsa.** Similar to latter. Brazil.
Bactris (Guilielma) utilis. Peach-nut; Pejibaye; Pewa; Pupunha. Slender stems; whole palm spiny, 30–40 ft. Fruit in clusters, reddish-yellow, eaten boiled with salt or roasted. See *Trop. Fruits.*
Bentinckia Condapanna. Travancore. Slender sp. about 30 ft. high.
Calamus. See under *Canes or Rattans*, also *Ceylon Palms.*
Calyptrocalyx spicatus. Moluccas. 30–40 ft. Bright red berries on long spikes.

Caryota Cumingii. Philippines. Handsome genus with bi-pinnate lvs. **C. ochlandra.** China. **C. rumphiana.** Malaya and Australia. **C. urens.** Toddy Palm. Trop. Asia. Handsome, bi-pinnate lvs.; 50–60 ft. Flowering spadices 7–9 ft. long, in huge bunches. See *Sugar Palms.*
Catoblastus praemorsus. Small palm of Venezuela.
Ceroxylon andicola. Colombia, etc. Wax Palm. See *Waxes and Gums.*
Chamaedorea elegans. Mexico. Dwarf, single stem; fl's. when 2–3 ft. high. ***C. Sartorii,** and **C. Tepijilote.** Mexico. Dwarf, elegant spp.
Chrysalidocarpus lutescens. Madagascar. Cane Palm. Many stems; handsome, fine, feathery lvs.; excellent for pot culture.
Cocos flexuosa. Brazil. 30–40. Handsome feathery lvs.; also **C. insignis. C. nucifera;** Coconut Palm. Nat. hab. unknown. See *Oils.* **C. plumosa** and **C. schizophylla.** Brazil. Handsome palms, 40–50 ft. **C. weddelliana.** Brazil. Small elegant sp. with fine pinnae. **C. romanzoviana.** Brazil.
Cyrtostachys Renda (= **C. Lakka**). Sealing-wax Palm; Pinang-rajah. Bright red leaf-sheaths, numerous stems. Sumatra.
Desmoncus major. Climbing palm, very spiny; small, round, red fruit. Trinidad.
Dictyosperma album. Mauritius. **D. fibrosum.** Madagascar.
Didymosperma distichum. Sikkim. See **Wallichia disticha. D. porphyrocarpus.** Java. **D. tremulum.** Siam.
Diplothemium caudescens. Very handsome, small palm. 10–12 ft. Brazil.
Drymophloeus appendiculatus. Malaya. **D. ceramensis.** Moluccas.
Dypsis madagascariensis. Many stems; pinnae in whorls. Madagascar.
Elaeis guineensis. Oil Palm. See *Oils.*
Eugeissona triste. Ovoid, smooth, prettily marked brown, pointed fruit; common spiny palm of Malacca, etc.
Euterpe edulis. Tender stem-tops edible, used as a vegetable in Brazil, etc. **E. oleracea.** Cabbage Palm. 80–100 ft. Top part edible. Brazil.

Group of Palms in Botanic Gardens, Henaratgoda, Ceylon.
1, *Jubaea spectabilis,* Coquito Palm; 2, *Corypha umbraculifera,* Talipot Palm, in flower; 3, *Thrinax argentea;* 4, *Loxococcus rupicola;* 5, *Oncosperma fasciculata;* 6, *Phoenix rupicola;* 7, *Ravenala madagascariensis.*

Geonoma gracilis; Costa Rica. **G. princeps;** Colombia. **G. schottiana;** Brazil. All small elegant spp.
Guilielma speciosa. Peach Palm; Pejibaye. See Bactris.
Hedyscepe canterburyana. 25–30 ft. Lord Howe's Island.
Heterospathe elata. Amboyna.
Hydriastele wendlandiana. Slender palm; small round, scarlet fruit. Queensland.
Hyophorbe amaricaulis. Mauritius. **H. Verschaffeltii.** Rodriguez.
Jubaea spectabilis. Coquito Palm. Chile. Very handsome palm. See fig. above.
Kentia (Howea) australis; K. belmoreana; and **K. forsteriana.** Single stem, handsome pinnate lvs.; favourite palms for pot culture in Europe, etc. Lord Howe's Island. **K. sanderiana.** A recent introduction.
Korthalsia Junghuhnii. Java. Spiny climber, like Calamus.
Manicaria saccifera. Bussu Palm; Tamite. Cent. Amer.
Martinezia caryotaefolia; M. lindeniana. Colombia. Spiny lvs. and stem.

Mauritia flexuosa. Brazil. Spiny. Inhabiting marshes.
Maximiliana regia. Cocurita; Inaja- or Jagua-Palm. Brazil and Guiana. Large handsome sp.
Metroxylon Rumphii. Prickly Sago-Palm. Moluccas and New Guinea. **M. Sagu.** Sago Palm. Malaya, etc. See *Sago.*
Myrialepis Scortechnii. Strong growing climber, spiny lvs. and stem. Malaya.
Nephrosperma van-houtteana. Erect, slender stem. Seychelles.
Nipa fruticans. Nipa; Water-Palm. See *Sugar Palms,* etc.
Oncosperma fasciculata. See *Ceylon Palms.* **O. filamentosa;** Nibung-Palm of Java. Many stems; handsome, drooping pinnae.
Orania regalis. Pericarp edible. Tall palm with smooth stem. Philippines.
Oreodoxa oleracea. Palmiste. Cabbage Palm. Trop. Amer. 80–100 ft., very stately, cylindrical stem; effective in avenues. Top part edible.

Avenue of Cabbage Palms (*Oreodoxa oleracea*), in Royal Botanic Gardens, Ceylon.

Ivory-Nut Palm (*Phytelephas macrocarpa*).
1, Male palm, showing staminate inflorescence; 2, female, showing fruit clusters at base; 3, section of a single fruit showing hard, white seeds.

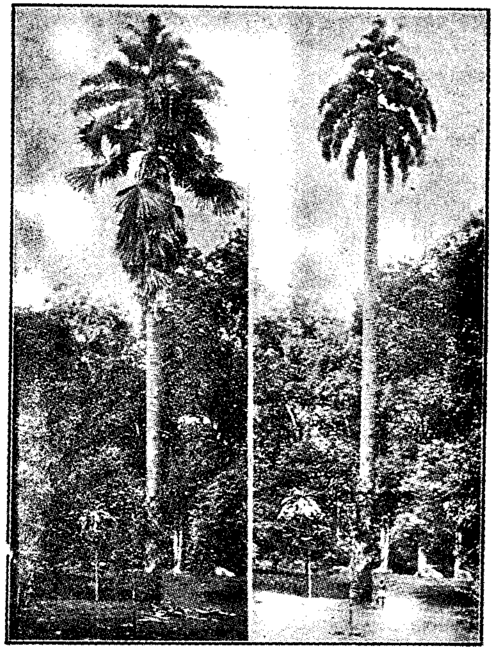
O. regia. Royal Palm; Bottle Palm. Cuba, Panama, etc. Stem usually barrel-shaped. Tender top portion edible, commonly used as a vegetable.
Phoenix dactylifera. Date Palm, which see. **P. paludosa.** India and Cochin China. **P. reclinata.** S. E. Africa; both elegant spp. **P. Roebelinii.** A handsome sp., with long, narrow arching lvs. and slender leaflets; a favourite for pots. **P. rupicola.** Sikkim. Fronds 15–20 ft. long. The handsomest of the genus.
Phytelephas macrocarpa. Ivory-nut Palm. Colombia. See *Waxes and Gums.*
Pinanga Kuhlii. Java. **P. paradoxa;** and **P. spectabilis,** Malaya. All small spp. with several stems, in clusters.
Plectocomia elongata. Sumatra, etc.
Prestoea trinitensis. Trinidad.
Ptychandra glauca. Single stem. Malaya.
Ptychococcus paradoxa. New Guinea.

Wallichia disticha.
Fan-shaped feathery Palm.

Ptychoraphis augusta. Nicobar Islands. **P. singaporensis.** Malaya.
Ptychosperma Macarthuri. Trop. Australia. Small and bushy, several stems; suited for pots. **P. perbreve.** Fiji. And other spp.
Raphia Hookeri and **R. vinifera.** Trop. Africa; **R. Ruffia** (= **R. pedunculata**). Madagascar. See *Piassava Fibre.*
Rhopaloblaste hexandra. Moluccas. 80–100 ft., single, slender stem; narrow pinnae, ornamental in small state.
Roscheria melanochaetes. Seychelles. Many stems, spiny.
Scheelea excelsa. Colombia. Handsome sp. with large, broad pinnae.
Synechanthus fibrosus. Guatemala. Single stem; bears masses of brown fibre at base of lvs.
Veitchia Johannis. Fiji.
Wallichia caryotoides. Burma, etc. **W. densiflora.** Himalaya region. **W. disticha.** Sikkim. Distinct, fan-shaped; lvs. ranged in 2 rows (distichous).
Zalacca edulis. Malaya. Stemless, very spiny.

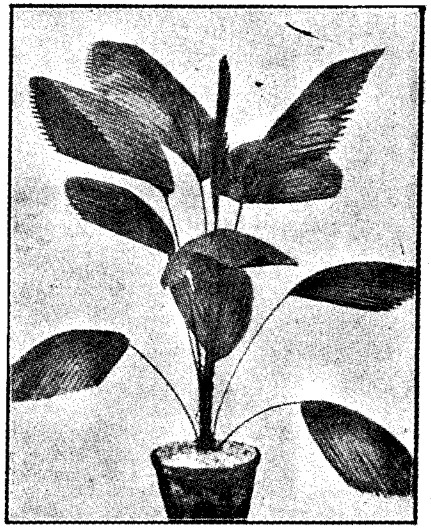
FAN-LEAVED PALMS

Bismarckia nobilis. Madagascar.
Borassus flabellifer. Palmyra Palm. India and Trop. Africa. See *Palmyra.*
Brahea nitida. Mexico. A small, slow-growing sp. with short stem; sub-tropical.
Copernicia cerifera. Carnauba Wax-Palm. See *Vegetable Waxes.*
Corypha umbraculifera. Talipot Palm. Ceylon and S. India. See *Talipot.*
Hyphaene thebaica. Doum Palm. One of the few branching palms. 30–40 ft. Fruit edible. Sudan, Upper Egypt, etc. See fig. on p. 161.
Latania Commersoni. Mauritius and Reunion. 40–50 ft. L. purplish, glaucous.
Licuala elegans. Sumatra. Small sp. with many stems; petioles prickly. **L. gracilis.** Java. Bushy, 5–7 ft. **L. (Pritchardia) grandis.** Pacific Islands. Single stem. 6–8 ft. L. almost circular, pleated fan-like; very elegant. **L. peltata.** Assam, Burma, etc. Large lvs.; single stem. **L. spinosa.** Bushy, 5–8 ft. Malaya.
Linospadix Micholitzii. Malaya.
Livistona altissima. Java. 60–80 ft.; petioles prickly; berries scarlet. **L. australis;** Australia. **L. chinensis;** China and Japan. **L. Hoogendorpii;** Java.

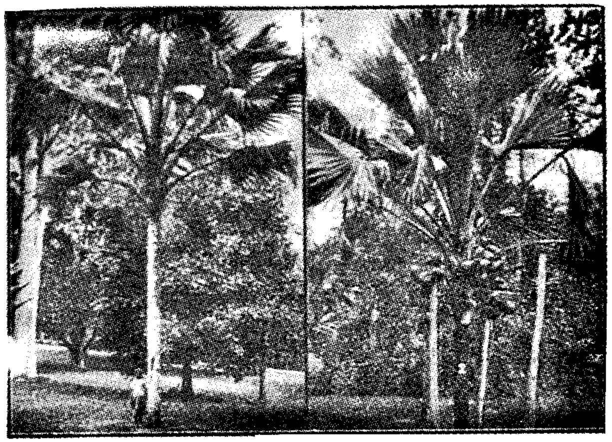


TALIPOT PALM (*Corypha umbraculifera*).
Left, in full flower; *Right,* same palm in fruit twelve months later.

L. humilis; Australia. **L. Jenkinsiana;** Assam. **L. olivaeformis;** Java. **L. rotundifolia** (small, blue-skinned, round fruit); Malaya. **L. subglobosa;** Java.
Lodoicea sechellarum. Double Coconut; Coco-de-mer or Sea Coconut. Seychelles. A remarkable dioecious palm with immense lvs.; stem up to about 80 ft. or more, to attain which it may take 50–80 years. Normally it does not flower under 30 years of age. Bears clusters of enormous nuts, each with husk weighing up to 45 or 50 lb., taking about 10 years to ripen. The nut is 2-lobed, rarely 3-lobed, and on being sown takes about 2 years to germinate. This is the largest seed known. Introduced to Ceylon in 1850. The large, hard-shelled nuts, formerly objects of many legends and superstitions and supposed to be a product of the sea, were found floating in the Indian Ocean long before the palm itself was discovered. See over.
Phoenicophorium sechellarum. See *Stevensonia grandifolia.*
Pholidocarpus Ihur. Malaya. Petioles spiny; lvs. like *Borassus.*
Pritchardia aurea and **P. grandis.** Fiji. See *Licuala.* **P. Martii.** Sandwich Islands. **P. pacifica.** Fiji.
Sabal blackburniana. Bermuda. Thatch Palm. **S. glaucescens.** Trinidad. 40–50 ft.; lvs. glaucous beneath. **S. filamentosa.** Jamaica. **S. umbraculifera.** Thatch Palm of Jamaica.
Stevensonia grandifolia. Seychelles. 40–50 ft., single stem; lvs. spiny, reddish tint when young.
Teysmannia altifrons. Sumatra. Short stem, petiole spiny.
Thrinax argentea. Broom Palm. W. Indies. Slender stem, 20–30 ft. Petioles slender, enveloped at base with brown, fibrous network. **T. barbadensis;** Barbados. **T. excelsa, T. parviflora;** W. Indies.
Verschaffeltia splendida. Seychelles. Handsome sp. with stilt roots; petioles and top of stem spiny.



FAN-LEAVED PALM (*Licuala grandis*).



DOUBLE COCONUT or COCO-DE-MER (*Lodoicea sechellarum*). 1, Male tree in Peradeniya Gardens, 72 years old; 2, female in Henaratgoda Gardens (50 miles distant), 40 years old. The latter, artificially pollinated, bearing about 25 fruits, the oldest about 10 years and ripening at time of photograph (1922).

Avenue of TALIPOT PALMS (*Corypha umbraculifera*). The giant of palms.

SUB-TROPICAL PALMS

Brahea dulcis. Mexico. Fan-leaved, dwarf sp. **B. filamentosa** (= **Washingtonia filifera**) (*q.v.*).
Ceroxylon andicola. Wax-palm of Colombia. See *Waxes and Gums*.
Chamaerops fortunei (= **Trachycarpus excelsus**). Fan-leaved. S. China. **C. humilis.** Fan-leaved, dwarf sp. S. Europe; the only European palm. **C. macrocarpa.** N. Africa.
Erythea armata. Fan-leaved. **E. (Brahea) edulis.** S. California.
Exorrhiza wendlandiana. Fiji.
Nannorhops ritcheana. N. India. Small bushy palm. L. used for fans, baskets, etc.
Rhapis flabelliformis. S. China. Small slender palm, numerous stems; used for walking-sticks.
Rhopalostylis (Areca) sapida. Nikau Palm. New Zealand. Small, pinnate-leaved.
Sabal Adansoni. Dwarf Palmetto. Fan-leaved, dwarf sp. **S. Palmetto.** Palmetto or Thatch Palm. S. United States.

Serenoa serrulata. Saw Palmetto. S. United States. Dwarf, elegant, fan-leaved.
Trachycarpus excelsa. S. China. Fan-leaved, dwarf sp.
Washingtonia filifera. Lower California. Handsome fan-leaved; leaf-margins copiously furnished with long, creamy-white, filiform threads.

CEYLON INDIGENOUS PALMS

(Those marked * are endemic, *i.e.* confined to Ceylon.)

Areca catechu. Betel-nut; Puwak, *S*; Kamukai, *T*. Moist low-country. Stems straight, slender, 25–40 ft. L. pinnate. ***A. concinna.** Lena-teri, *S*. Moist low-country. Small slender sp. 8–12 ft.
Borassus flabellifer. Palmyra; Tal, *S*; Panai, *T*. See *Sugar Palms*, also *Fibres*.
***Calamus delicatulus.** Narawel, *S*. Moist low-country up to 1,000 ft.; climbing palm, with spiny, elegant, pinnate lvs. The slender stems of several spp. form the "canes" of commerce. See *Rattans*. Other spp. of Canes are: ***C. digitatus**; Kukula-wel. ***C. ovoideus**; Thambutu-wel. ***C. pseudo-tenuis.** ***C. pachystemonus**; ***C. radiatus**; ***C. rivalis**, Ela-wel. **C. Rotang.** Wé-wel, *S*; Perampu, *T*. Chiefly dry region. ***C. Thwaitesii** and ***C. zeylanicus.** Moist low-country up to 1,000 ft.
Caryota urens. Toddy Palm. Kitul, *S*. Moist low-country up to 3,000 ft. Trunk 50 to 60 ft.; lvs. bipinnate, very handsome; drooping spadices, 7–9 ft. long.
Cocos nucifera. Coconut; Pol, *S*; Tennai, *T*. Cultivated only. See *Oils*.
Corypha umbraculifera. Talipot; Tal-gaha, *S*. Moist region below 2,000 ft. Trunk stout, erect, 60–80 ft. L. immense, 12–15 ft. diam. Seeds the size of large marbles, ivory-like, made into buttons, etc. See pp. 159, 160, 501.
***Loxococcus rupicola.** Dotalu, *S*. Moist region, 1,000–5,000 ft. Stem slender, erect, 15–20 ft. L. pinnate, with broad pinnae.

DOUM PALM (*Hyphaene thebaica*). One of the few branching palms.

Nipa fruticans. Nipah; Gin-pol. Root-stock 1½ ft. diam. L. pinnate, 15 ft. or more. Brackish waters only. See *Sugar Palms*.
Oncosperma fasciculata. Katu-kitul, *S*. Moist region up to 1,500 ft. Stems many, clustered, spiny, 40–60 ft. L. pinnate; pinnae long, pendulous.
Phoenix pusilla. Inchu, *T*. Forest of dry region. Stem stout. L. 4–5 ft., lower pinnae reduced to spines. **P. zeylanica.** Indi, *S*. Moist low-country. Stem 6–15 ft. L. pinnate, with numerous, long, narrow pinnae; made into "Kalutara" hats, baskets, etc.

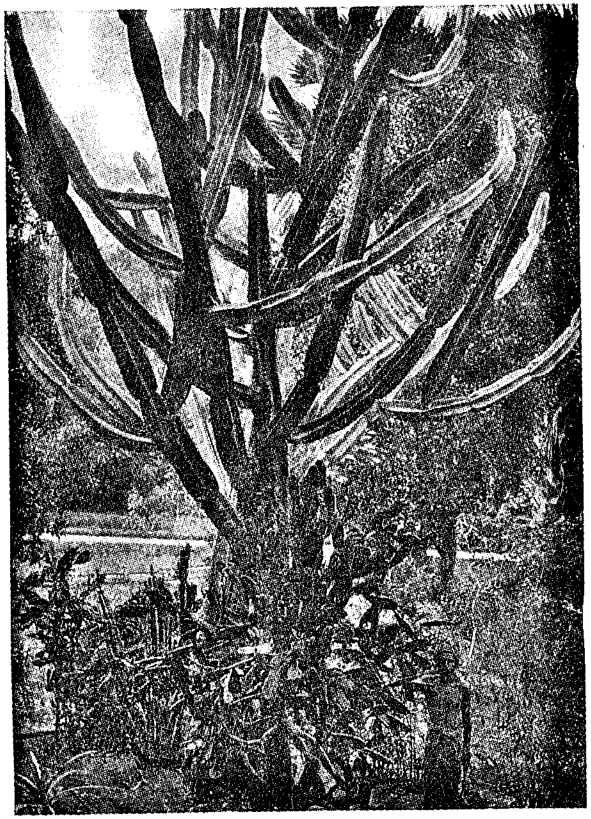
M

SELECTED CACTI OR SUCCULENT PLANTS

Plants of this class are generally suited only to very dry sub-tropical regions, the great majority being indigenous to the drier parts of Mexico, California, Argentina, Peru and S. Africa. The Cactus family (*Cactaceae*) are remarkable on account of their curious, leafless, often branchless, spiny and grotesque forms. In most cases they consist of a fleshy, juicy mass of tissue, armed with formidable, radiating spines in bunches, or are furnished with bristles or long white hair. They are of very slow growth, withstand a drought which few other plants will survive, and many have showy flowers.

The group includes numerous genera and succulent forms, as many Euphorbia, which often closely resemble the Cacti but may be readily distinguished by their milky juice. Other fleshy forms of vegetation commonly included in this class are Agave, Bromelia, etc., which, however, thrive in a moist as well as a moderately dry climate. Among these is the **Century Plant** (Agave), which is commonly but erroneously supposed to bloom once in a hundred years. This depends on the condition under which the plants are grown, as they may flower when only 7–10 years old, though under less favourable conditions may take 20–25 years, but seldom, if ever, more.

For abbreviations, see heading to Chap. XII, p. 102. Those marked * flourish in a moist climate up to about 4,000 ft.



GIANT CACTUS (*Cereus peruvianus*).
In foreground, *Nopalea coccinellifera*.

***Agave americana variegata.** Century Plant. *Amaryllideae.* S. Amer. Stemless plant. L. large, succulent, variegated, spiny, sharp-pointed. ***A. densiflora.** Mexico. Large, succulent, sharp-pointed, spiny lvs. ***A. heteracantha.** Texas, etc. Similar to latter sp. ***A. Morrisii.** Jamaica. L. rather broad, spathulate and curved at base. (Su. or S.)

Aloe saponaria. S. Africa. *Liliaceae.* Small plant with short stem and succulent, prickly, spotted lvs. (C.) Many other spp.

***Bromelia Pinguin.** *Bromeliaceae.* Trop. Amer. 5–8. Stemless plant, with long strap-shaped lvs. edged with sharp hooked spines. (S. or Su.) See *Fibres*.

***Caralluma campanulata.** *Asclepiadeae.* Ceylon and India. Dwarf leafless plant; square stems. (C.)

Cephalocereus senilis. Old Man Cactus. Erect stout stem, surmounted by copious whitish-grey hair.

***Cereus grandiflorus.** Night-flowering Cactus. *Cactaceae.* W. Indies. Large creeper, reaching the tops of tall trees. Fls. large, white, opening at night. (C.) **C. jamacaru.** Brazil. Stout, single, leafless, unbranched stem, 4–5-angled. (Off.) ***C. peruvianus.** Torch Thistle; Giant Cactus. S. Amer. 30–40 ft. or more. Large, branching tree without lvs. Branches 5–6-angled, spiny. Large white fls., which open at night. Fig. on p. 162. ***C. serpentinus.** Mexico. Creeper with thin, hairy, tail-like stems. (C.)

Dasylirion acrostichum. *Liliaceae.* Stout unbranching stem, 15 ft. Spiny lvs.

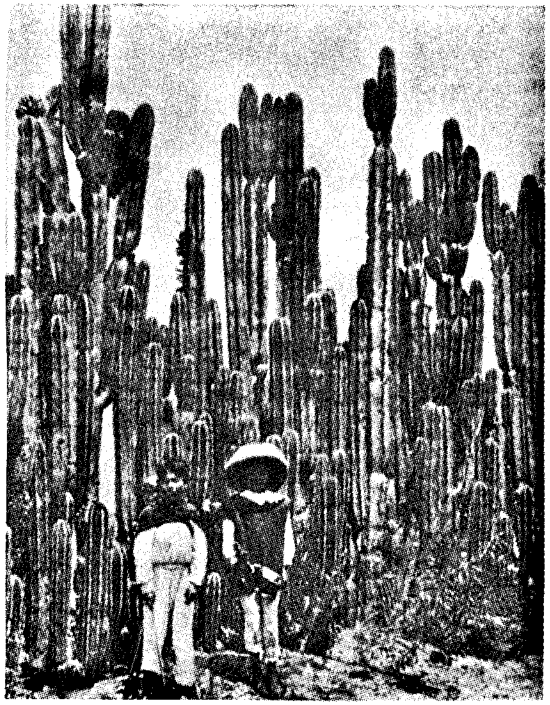
Dyckia altissima. *Bromeliaceae.* 1 2. L. narrow, wiry and recurving. (Off.)

Echinocactus. *Cactaceae.* Numerous spp. Mexico. Small, unbranched, ovoid or globose, succulent, spiny plants. Many spp. (Off.)

Echinopsis (Cereus) multiplex. *Cactaceae.* Brazil. Erect unbranching plant with several spine-covered angles. (Off.)

***Epiphyllum truncatum.** *Cactaceae.* Brazil. Small leafless sh., with ornamental bright pink fls. Numerous other spp. (C.)

Euphorbia Antiquorum. Leafless spreading tree, 20–30 ft. high. Branches 3-angled, with stout prickles. Ceylon, India, etc. See *Poisonous Plants*. **E. canariensis.** Similar to above. Canary Islands.



ORGAN CACTUS (*Pachycereus marginatus*), USED FOR HEDGES IN MEXICO.

Furcraea gigantea. Mauritius-hemp. See *Fibres*.

Gasteria trigona. Salm-Dyck Aloe. *Liliaceae.* S. Africa. ½–1. L. very thick, distichously arranged. **G. verrucosa.** S. Africa. ½–1. Thick, warty lvs. (Off.)

Haworthia attenuata, and numerous other spp. *Liliaceae.* S. Africa. Small Aloe-like plants, lvs. in a rosette. (Off.)

***Kalanchoe laciniata.** Life-plant. *Crassulaceae.* Trop. Africa. L. deeply cut. (C.)

Lomatophyllum borbonicum. *Liliaceae.* Bourbon. Long, fleshy lvs., spiny at edges, on short stem, 2–3. (S.)

Mamillaria glauca. *Cactaceae.* Mexico. Dwarf plant, composed of many tubercles, each bordered by spines in bunches. **M. megacantha** and **M. nobilis.** Mexico. Numerous other spp. (Off.)

Nopalea coccinellifera. Spineless Cactus. *Cactaceae.* Mexico. 6–8. Branching.

leafless sh. with flat, oval tubercles without spines. Also known as Cochineal Cactus. See *Dyes*, also fig. on p. 162.
Opuntia Dillenii. Prickly Pear; Katu-patuk, *S. Cactaceae.* Mexico. 5–7. Branching leafless sh. with large circular or oval tubercles, covered with tufts of sharp spines, 3–4 in. long. Some forms are almost spineless. See *Weeds*, etc. **O. grandis** and **O. robusta.** Mexico. Both similar to preceding sp. (C.)
Pachycereus (Cereus) marginatus. Organ Cactus. Upright, sparsely branched stems; commonly used in Mexico for hedges, etc. **P. monstrosa.** Entirely spineless, ovoid succulent structure.
Pedilanthus tithymaloides. *Euphorbiaceae.* S. Amer. 4–6. Erect sh. Also a green and white variegated form. Sometimes used as hedges. (C.)
Phyllocactus amabilis. *Cactaceae.* Small sh. with flattened, leaf-like branches; fls. showy, bright pink and other shades. **P. crenatus, P. grandis, P. speciosissima** and other spp. Trop. Amer. (C.)
Pilocereus Schottii. Upright, 4-angled stout stem, with fine bristles along each angle.
***Rhipsalis Cassytha.** *Cactaceae.* Trop. Asia. Epiphytic leafless plant, with cylindrical slender stems and branches. The only Asiatic Cactus. (C. or S.) **R. pachyptera.** W. Indies. Large, flat, leaf-like branches. (C.)
***Stapelia grandiflora.** *Asclepiadeae.* S. Africa. Small leafless, 4-angled plant. (C.)
Vitis quadrangularis. *Ampelideae.* Trop. Asia, etc. Climber with square succulent stems. (C. or Tu.)
Yucca gloriosa. Adam's Needle, etc. See *Orn. Flowering Shrubs.*

ORNAMENTAL GRASSES AND SEDGES

Those marked * are best suited to medium or high elevations.

Anthistiria gigantea. Malaya. A handsome grass, 5–7 ft. high, with large, graceful, drooping, flowering panicles.
Arundo Donax variegata. Giant Reed. A bushy variegated grass, about 6–10 ft. high, excellent for ornamental effect. Variegation is best developed in poor sandy soil and sunny situation. Mediterranean, Egypt, etc.
***Briza maxima.** Quaking-grass. A small grass with elegant drooping panicles, valued for bouquets and cut-flower decorations. **B. minima** is a smaller form.
Carex brunnea variegata. India. 1 ft. Suitable for growing in pots. (Div.)
Coix Lacryma-Jobi. Job's Tears; Kirindi-maana, *S.* Ceylon, India and Malaya. An annual, 3–5 ft. high with hard, ovoid, bead-like fruit. See *Cereals.*
***Cyperus alternifolius.** Umbrella-plant. An ornamental sedge, each leaf-stalk bearing an umbel of radiating lvs. See *Pot Plants.* Africa, nat. in W. Indies. **C. Papyrus.** Egyptian Papyrus. Egypt, Sudan, etc. A large, very handsome sedge, 6–8 ft. Stout, 3-angled leaf-stalks (culms), bearing at top an umbel of drooping filiform lvs. 10–20 in. long. Suitable for swamps or water margins. See *Fibres*, also fig. on p. 167.
***Euchlaena (Reana) luxurians.** Teosinte. Guatemala. An annual grass, 8–10 ft. high or more; lvs. 3-4 ft. long and 2–3 in. broad. Very handsome when in flower. See *Fodder Grasses.*
***Eulalia zebrina.** Zebra-grass. Japan. Stems and lvs. with transverse bands of pale yellow and dark green, about 3 ft. high.
Garnotia Fergusoni. Ceylon. Graceful, bushy grass; fls. in long panicles, 2–3 ft.
***Gynerium argenteum.** Pampas Grass. S. Amer. Sometimes cultivated commercially for its handsome, erect, white, silvery flowering plumes, 6–7 ft. high. Replant every 3rd or 4th year and manure well. Fig. on p. 179.
***Isolepis gracilis.** Sub-tropics. A favourite pot-plant for greenhouse and conservatory decoration, with pendulous filiform lvs., 6–9 in. long.
Oplismenus Burmannii variegatus. New Caledonia. An ornamental, creeping, variegated grass, the lvs. being white with a central green or pink stripe.
***Panicum plicatum.** Ceylon, India, etc. A striking grass, with large, broad lvs., 3–4 ft. ***P. pulchrum.** Ornamental sp., 2 ft.
Pennisetum longistylum. Abyssinia. A striking sp., 4–5 ft.
***Phalaris arundinacea.** Ribbon Grass, or Gardener's Garter. S. Europe. A small variegated grass, suitable for edgings, etc.
Tricholaena rosea. Red-top Grass. Natal. A handsome grass when bearing its masses of purplish crimson fls., 1½–2 ft. high.

Bambusa siamensis.
A graceful feathery Bamboo.

BAMBOOS AND BAMBOO-LIKE GRASSES, ETC.

Those marked * are best suited to medium or high elevations.

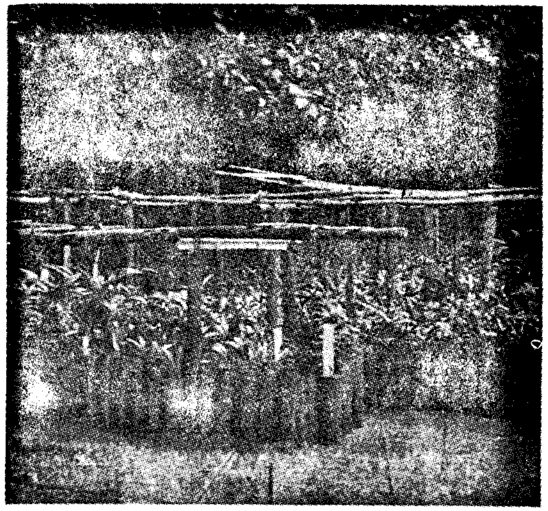
Bamboos of many different kinds form one of the most striking features of tropical vegetation. They vary considerably in size and character, some growing only a few feet in height, others 100 ft. or more, with stout erect stems, whilst others are climbers or straggling shrubs. The smaller kinds are usually suited only to the higher altitudes or sub-tropical conditions, and the larger species thrive best at the lower elevations. All like a sheltered and moist locality and deep retentive soil. They are readily propagated in rainy weather by suckers, division of the root-stock, or by mature joints with buds.

Arundinaria suberecta. A dwarf, elegant grass-like bamboo, with delicate, drooping foliage, 12–16 in. A favourite pot-plant; stands sun and drought well.
***Bambusa aurea.** Japan. Stems yellow; light open foliage, very ornamental, 20–25 ft. ***B. metake.** "Female Bamboo." Japan. 10–15 ft.; stems erect. **B. nana.** See *Hedges.* ***B. nigra.** India. An interesting sp., 25–30 ft.; stems dark purple when young. **B. siamensis.** Burma and Siam. 25–30 ft. Fine foliage, in graceful plumes. An exceedingly handsome bamboo. See fig. above. **B. vulgaris.** Una, *S.* Yellow- or Golden-Bamboo. Ceylon and tropics generally. A very handsome sp., 35–50 ft., pale yellow stems, streaked with green, 3–4 in. in diam. Most useful for scaffolding, building, plant-pots, etc. Thrives best on river banks, up to 4,500 ft. in valleys.
Dendrocalamus giganteus. Giant Bamboo. Burma. A magnificent sp. attaining a height of over 100 ft., with clumps 40–50 ft. in diam.; stems 10 in. or more in diam. Used for building, plant-pots, water-spouting, umbrella stands, etc. The young shoots grow

GIANT BAMBOO (*Dendrocalamus giganteus*).
The largest of all Bamboos.

at the rate of a foot a day. (Fig. on p. 165.) **D. Hamiltonii.** Trop. Himalaya. A fairly large sp., suited to medium elevations. **D. strictus.** "Male" or "Solid" Bamboo. India, Java, etc. A moderate-sized spreading sp., about 30 ft. high. Stems 2–2½ in. or more in diam., sometimes almost solid; used for shafts, lance staves, fence posts, etc.

Gigantochloa aspera. Building Bamboo. Java. A graceful sp., resembling the Giant Bamboo, 80–100 ft. or more, with stout, strong stems, 6–8 in. in diam. See below.

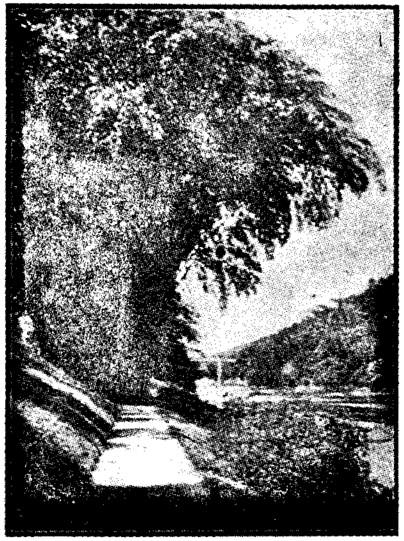


Bamboo Pots as used for Raising Plants.

Gynerium saccharoides. Trop. Amer. A tall, handsome reed, 15–20 ft. high, with long ribbon-like lvs.

Melocanna bambusoides. Fruiting Bamboo; Muli (of Assam); Kayiu (of Burma). A remarkable gregarious bamboo; stems isolated, not in close clumps; bears large, pear-shaped, fleshy fruit, 2–3 in. or more in diam. The enlarged pericarp is edible.

Ochlandra maculata. Mottled Bamboo; Rana-bata-li, *S.* 12–15 ft. Lvs. 8–10 in. long by 2½ in. broad; stems blotched with brown; used for fancy furniture. **O. Rheedii.** Quill Bamboo. 12–15 ft. L. broad and long. **O. travancorica.** S. India. 15–20 ft. Large bush; long and broad lvs.



Building Bamboo of Java (*Gigantochloa aspera*).

***Oxytenanthera Thwaitesii.** Ceylon and S. India. A large reed, 10–12 ft., lvs. 12 in. long by 1½ in. broad.

***Phyllostachys mitis.** A handsome Japanese bamboo, 20–25 ft. high. ***P. nigra.** A striking sp. with dark purplish stems. Japan.

Thysanolaena acarifera. Trop. Asia. A large, bushy, spreading reed, 8–10 ft., with large, broad lvs. Fls. in tall, greenish-white panicles.

ORNAMENTAL WATER PLANTS

Suited chiefly to low elevations.
(See also *Swamp Plants.*)

(Those in parentheses, though not aquatics, are adapted for growing in water, if in tubs or pots partly submerged.)

Acorus calamus. Sweet Flag; Wada-kaha, *S. Aroideae.* L. 3–4 erect. (Div. or S.)

1, Papyrus Grass (*Cyperus Papyrus*).
2, Umbrella Grass (*C. alternifolius*).

Aponogeton distachyum. Water Ribbon-weed. *Naiadeae.* L. narrow, floating; fls. pale blue or white. (Div.)

Azolla pinnata. *Rhizocarpeae.* Dwarf floating plants (pseudo-ferns) with pinnate lvs., forming a pretty light green or reddish sheet. Sporangia in leaf-axils.

(Carludovica palmata.) Large, palm-like lvs., 5–7. See *Fibres.*

Ceratopteris thalictroides. Water Fern. *Filiceae.* Fronds pinnate, edible in young state; 1½–2. (Div. or spores.)

(Chrysalidocarpus lutescens.) Handsome, bushy, feathery palm. (S.)

(Cyclanthus cristatus.) *Cyclanthaceae.* Large basal lvs., 5–6 ft. long. (Div.)

(Cyperus alternifolius.) Umbrella Grass. See *Grasses and Sedges.* **C. Papyrus.** "Papyrus," which see.

Eichhornia (Pontederia) crassipes. Water Hyacinth. *Pontederiaceae.* Upright, floating herbs; lvs. with large, swollen petioles; bears erect panicles of beautiful mauve or lilac fls. S. Amer. See *Weeds.*

Euryale ferox. *Nymphaeaceae.* Bengal. Large floating lvs. with erect spines. Seeds edible. Cultivated in China for the latter.

(Hedychium coronarium.) Fls. pure white, scented. (Rhiz.) **(H. gardnerianum.)** Fls. pale yellow. Suited to up-country.

Lasia spinosa. Kohilla, *S. Aroideae.* L. spinous, pinnatifid. (Div.)

Limnanthemum indicum. Water Snow-flake. *Gentianaceae.* L. floating, cordate. Fls. dingy white. (Div.)

Limnochairis (Hydrocleis) Humboldtii. Water Poppy. *Alismaceae.* L. oval, floating; fls. bright yellow. (Div. or S.) **L. Plumieri.** L. erect, pale green; fls. small, yellow. (Div.) Brazil.

(Ludovia crenifolia.) See *Fol. Pot Plants.*

Marsilea quadrifolia. *Rhizocarpeae.* Small clover-like plant; each leaf composed of 4 leaflets, closing at night; allied to the Ferns. Fruit springing from rhizome, divided into several cells. (Div. or spores.)

Monocharia hastaefolia. Diya-habarala, *S. Pontederiaceae.* Fls. brilliant purplish-blue. (Div.)

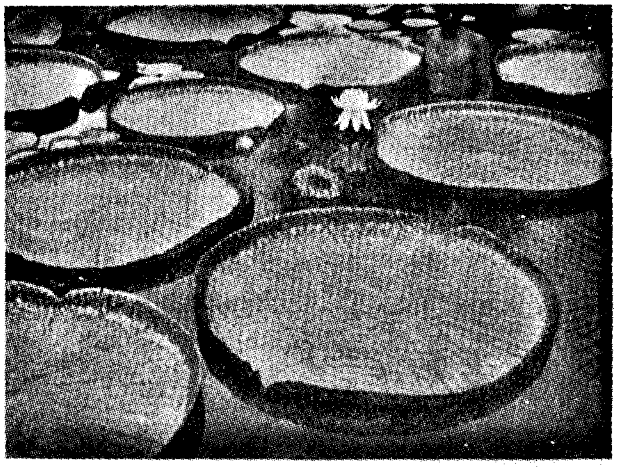
Myriophyllum proserpinacoides. *Halorageae.* Floating or submerged feathery lvs., in whorls of 4–6. (Div.)

Water Lilies in Peradeniya Gardens, Ceylon.
1 and 4, *Victoria regia*; 2 and 3, *Nelumbium speciosum.*

Nelumbium (Nelumbo) speciosum (=**N. nucifera**). Lotus Lily; Sacred Lotus; Nelun, *S. Nymphaeaceae.* India, Tibet, China, etc. L. large, handsome, peltate, circular, erect; fls. large, bright pink or white, scented, on stout stalks. L. incapable of being wetted, owing apparently to waxy surface, but really to closely set minute hairs. A beautiful plant, introduced to Egypt 500 B.C., but nowhere found wild there now. Seeds and root-stock edible. (S. or Tu.) See *Sacred Plants.*

Nipa fruticans. Nipa or Water Palm. See *Sugar Palms*, etc.

Nymphaea Lotus. Water Lily; Olu, *S. Nymphaeaceae.* Large, floating lvs. Fls. pale pink to bright crimson; open at night. Seeds edible. (Tu. or S.) **N. lutea.** Fls. yellow, showy. **N. stellata.** Manel, *S.* Fls. whitish-violet or pale blue. Liable to become a pest in up-country still waters. **N. sulphurea.** Fls. pale to deep yellow. (Tu. or S.)



GIANT WATER LILY (*Victoria regia*).

Ouvirandra fenestralis. Lattice-leaf Plant. *Naiadaceae.* Madagascar. Curious lace-like floating lvs. (Tu.)

Oxystelma esculentum. Kulappalai, *T. Asclepiadeae.* Ceylon. Ornamental twiner with cream and pink fls. (S. or C.)

Pistia stratiotes. Water Lettuce. *Aroideae.* Small, floating, pretty rosette-like water herbs, resembling small cabbage-lettuces. See *Water Weeds.* (Div.)

Pontederia crassipes. Water Hyacinth. See *Eichhornia.*

Sagittaria sagittifolia. Arrow Head. *Alismaceae.* Large, sagittate lvs. (Div.)

Schizocasia (Alocasia) Portei. *Aroideae.* Very large pinnatifid lvs.; stem 5–6 ft. or more. (Su.) New Guinea. Fig. on p. 147.

Susum anthelminticum. Induru, *S. Flagellariaceae.* Long, floating, leafy shoots, with large, erect panicles. (S. or Div.)

Typha angustifolia. Bulrush. *Typhaceae.* Erect, ribbon-like lvs.; fls. in long cylindrical brownish heads, borne on long stalks, 4–6. (Div.) Trop. Asia.

Victoria regia. Giant Water-Lily. *Nymphaeaceae.* Immense, tray-like, floating, circular, peltate lvs., 5–7 ft. in diam., with a raised margin of about 3 in.; fls. large, pink or cream, open at dusk, strongly scented. A remarkably handsome plant of Guiana, introduced at Peradeniya, Ceylon, in 1896. (S.)

CHAPTER XV

SELECTIONS OF ORNAMENTAL PLANTS, TREES, ETC. SUITABLE FOR UP-COUNTRY

1. *FLOWERING TREES.*
2. *FOLIAGE TREES.*
3. *FLOWERING SHRUBS AND HERB. PERENNIALS.*
4. *FOLIAGE SHRUES & HERB. PERENNIALS.*
5. *ORNAMENTAL CLIMBERS AND CREEPERS.*
6. *BULBOUS AND TUBEROUS PLANTS.*
7. *ROSES.*
8. *SHOWY ANNUALS AND PERENNIALS.*
9. *SELECTED PLANTS FOR POT-CULTURE UP-COUNTRY.*

ORNAMENTAL FLOWERING TREES FOR UP-COUNTRY

(Those in larger type are of chief importance.)

Acacia dealbata. *Leguminosae.* Silver Wattle; Mimosa Tree. A small evergreen Australian tree, with fine pinnate leaves, distinguished by the silvery-white under-side of the latter. Very ornamental when in flower, chiefly during January–March and September–October, with its large heads of yellow fragrant blossom. Excellent for wind-belts, but as a solitary tree its habit of sending up numerous suckers, which when once well established are difficult to eradicate, is an objection. Commonly grown at the higher elevations in India, Ceylon, etc.

A. baileyana. A beautiful flowering and foliage tree of New South Wales, characterised by slender shoots and glaucous-green leaves, not unlike *A. dealbata*, bearing very long sprays of rich yellow flowers. Grown in the Riviera commercially for the sake of the latter. The tree is grown on some up-country estates in Ceylon.

A. cultiformis. Knife-leaved Acacia (in reference to the phyllodes). A small tree or large shrub, with pale yellow flowers, produced in the dry weather twice a year, and small oblong glaucous phyllodes which end in small sharp prickles. The tree is also ornamental on account of its foliage.

A. decurrens. (Running down, in allusion to the union of the leaves with the stem.) Common or Black Wattle. Bears a profusion of fragrant yellow flowers in the dry season. (See *Tans*, also *Timber and Fuel Trees.*)

A. elata. Mountain Hickory. Australia. A handsome species with large, pale yellow inflorescence and open, feathery drooping foliage. Thrives at Hakgala Gardens, Ceylon.

A. longifolia. (Long-leaved.) Sydney Golden Wattle. A small, spreading tree, very ornamental when in blossom, viz. during February–March and July–August, the flowers being pale yellow.

A. pycnantha. (Dense-flowered.) Golden- or Broad-leaved Wattle. A medium-sized tree, with undivided leaves (phyllodes), native of S. Australia. Very ornamental during the dry season, when it bears masses of yellow blossom. Bark rich in tannin. (See *Tans*, also *Timber and Fuel Trees.*)

Callistemon lanceolata. *Myrtaceae.* Bottle-brush Tree. A small tree with stiff, narrow leaves, native of Australia. It blossoms all the year round, but chiefly

after the rains, when the scarlet flowers, crowded on shoots of the old wood in the form of a brush, are very attractive. Prop. by the minute seed, which should be sown under cover.

Calophyllum Walkeri. *Guttiferae.* Keena or Kina, *S.* A large, handsome, slow-growing tree with coriaceous leaves, bearing from January to April a profusion of pinkish-white, sweet-scented flowers; familiar as the Mountain Keena of Ceylon. **C. tomentosum** is the Keena of mid-country. (See *Fixed Oils.*)

Camellia japonica. *Ternstromiaceae.* Camellia. Small, slow-growing, erect, bushy trees or large shrubs of Japan, with coriaceous leaves and beautiful, fleshy, double flowers. Numerous varieties, scarlet, pink, white, etc. Wood hard. Prop. by seed or layers.

Elaeocarpus glandulifera. *Tiliaceae.* A medium-sized tree, very striking when in blossom, being literally covered with racemes of creamy-white flowers.

FLAME TREE OF QUEENSLAND (*Sterculia acerifolia*).

Eucalyptus ficifolia. *Myrtaceae.* Scarlet-flowering Gum. A small tree, native of W. Australia; the most showy of the Eucalyptus family, well worthy of cultivation for the sake of its large trusses of showy pink, crimson, or scarlet flowers, irrespective of its claims as a shade or avenue tree.

Grevillea Banksii. *Proteaceae.* A small tree or tall shrub, 15–20 ft., bears terminal racemes, 4–5 in. long, of crimson-pink blossom. Leaves silvery-white, pinnatifid, 6–9 in. long.

Hymenosporum flavum. *Pittosporaceae.* E. Australia. A small tree, introduced to Ceylon about 1882; bears during the dry weather a profusion of small, pale yellow flowers. Prop. by seed.

Meliosma arnottiana. *Sabiaceae.* A moderate-sized tree, indigenous to the montane zone of Ceylon; bears a profusion of creamy-white flowers in April, being deciduous in January. "A great ornament to the montane forests when covered with its sheets of cream-coloured blossoms" (Trimen).

Pittosporum undulatum. *Pittosporaceae.* Victorian Laurel. A small Australian tree, introduced and established at Hakgala Gardens; bears in March or April a profusion of fragrant, cream-coloured flowers.

Rhododendron arboreum. *Ericaceae.* Maha-ratmal, *S.* A small tree, 15–30 ft. high, common in the open patanas in the montane zone of Ceylon and S. India, above 5,000 ft. Very attractive when in blossom, bearing large clusters of dark-crimson or pink flowers, chiefly from May to August. Thrives in clayey or humous soil, without lime.

Spathelia simplex. *Rutaceae.* "Mountain Pride" of Jamaica. A small, unbranching, slow-growing tree, 30–35 ft. high, with a crown of feathery fern-like leaves, producing a terminal panicle of lilac-coloured flowers. Very striking when in blossom.

Spathodea campanulata. See fig. on p. 91. Thrives up to 4,000 ft.

Stenocarpus sinuatus. *Proteaceae.* Fire Tree or Tulip Tree of Queensland. An erect tree, 40–50 ft. high, very showy when bearing

its clusters of scarlet flowers, which are of peculiar construction. Large, deeply sinuate leaves. Established in Peradeniya Gardens, Ceylon, since 1883; thrives also at Hakgala. Flowers from May to July, and occasionally sets fruit here. Suited to elevations of 1,500–4,000 ft. or higher.

Sterculia acerifolia. *Sterculiaceae.* Flame Tree. A moderate-sized tree with large, glossy, angular-palmate leaves, native of S. Australia, introduced to Ceylon in 1882. It grows and flowers at comparatively low elevations, but is more suited to the higher altitudes, thriving up to 5,500 ft. in Ceylon. Produces in May and June, when bare of leaves, large masses of red blossom. Prop. by cuttings, or by seed when procurable.

ORNAMENTAL FOLIAGE TREES FOR UP-COUNTRY

Acacia decurrens var. mollissima. *Leguminosae.* Black- or Tan-Wattle. A handsome, quick-growing tree, 40–60 ft. high, native chiefly of E. Australia; thrives in the tropics at elevations of 4,000–6,000 ft., on almost any soil. It has of late become popular at the higher elevations in Ceylon for planting amongst Tea for green-manuring or for wind-breaks. Affords good timber and excellent fuel. About 1,790 of the small flat seeds weigh 1 oz. (See *Timbers*, also *Tans.*)

Stenocarpus sinuatus.
(A) Scarlet flowers; (B) fruit.

A. melanoxylon. Blackwood, or Leafless Acacia. A large, handsome tree, native of S. Australia, characterised by usually having phyllodes only for leaves, rarely bearing pinnate leaves except in the young state. It furnishes a handsome and excellent timber. "One of the best woods in Victoria for railway carriages, furniture, etc." Wood splits well for shingles. The tree is rather a greedy feeder, the roots spreading to considerable distances.

Acrocarpus fraxinifolius. Pink Cedar; Shingle Tree; Howlige-mara, *T.* *Leguminosae.* A medium-sized or tall, quick-growing, upright deciduous tree, with handsome, bipinnate leaves (crimson when young) and long, rather slender branchlets. Commonly grown in India as shade for Coffee. Wood used for shingles, furniture, tea-chests, etc. Seeds small, flattish, brown; 1,600 = 1 oz. Several other species.

Agathis (Dammara) robusta. (See p. 92.)

Ailantus glandulosa. A very handsome tree, 60–70 ft. high, with large pinnate leaves; native of Malaya, etc. Similar to it is **A. excelsa** (see p. 93).

Araucaria Bidwillii and **A. Cookii.** (See p. 93.)

A. excelsa. Norfolk Island Pine. A beautiful symmetrical tree, with regular tiers (whorls) of short, horizontal, spreading branches,

attaining a great height; commonly grown in temperate countries as an ornamental pot-plant. Thrives at medium and high elevations in the tropics.

A. Cunninghamii. Moreton Bay Pine; Hoop Tree. (See p. 93.)

Bucklandia populnifolia. *Hamamelideae.* A handsome tree, with large, leathery, glossy leaves, native of the Himalayas. Thrives at Hakgala Gardens, Ceylon, but has not yet fruited there.

Castanospermum australe. *Leguminosae.* Moreton Bay Chestnut. A moderate-sized tree with handsome pinnate leaves, native of Queensland, introduced to Ceylon in 1874. Bears stout brown pods, 6–8 in. long, containing 2–4 large chestnut-like seeds, which are edible though astringent. Thrives also at low elevations.

Casuarina equisetifolia. *Casuarineae.* (See p. 94.) **C. montana.** A handsome species on account of its very long, drooping, thread-like branchlets (not true leaves), which are sometimes 20–24 in. long. Specially suited to the higher elevations. **C. torulosa.** Similar to **C. equisetifolia**; suited to either high or low elevations.

1, *Cupressus macrocarpa*; 2, *C. funebris.* Both in fruit.

Cedrela serrulata. Red Toon; Red Cedar; Java Mahogany. *Meliaceae.* An upright, handsome tree with elegant, pinnate, serrated, long leaves, 50–60 ft. high, native of Sumatra, etc., much planted in the higher Tea districts of Ceylon for wind-breaks, timber, etc. Timber fragrant, of a reddish colour, easily worked.

C. Toona. Toon Tree; Indian Mahogany. India, Malaya, etc. A very handsome tree on account of its long, graceful, pinnate leaves, which when young are of a crimson tint. It grows to a height of 60 ft. or more, and yields excellent reddish timber of commercial value. (See *Timbers.*)

Cinnamomum Camphora. Camphor; Kapuru-gaha, *S.* A small or medium-sized, evergreen, bushy tree, suited to medium and high elevations. Usually furnished with foliage down to the ground, and generally assuming a conical shape, especially in a young state. (See *Camphor*, also *Wind-breaks.*)

Cryptomeria japonica. Japanese Cedar. *Coniferae.* An upright, conical, slow-growing tree, 25–50 ft. or more; leaves needle-shaped in bunches. Suited to high elevations in the tropics. Introduced to Ceylon about 1874, but rarely produces seed here, and is not long-lived. Native of Japan.

Cupressus (Chamaecyparis) funebris. Funeral- or Weeping-Cypress. (*Coniferae.*) North China. An elegant tree with graceful, drooping branchlets; a favourite tree, especially in the young state, for cemeteries. **C. knightiana.** A tall, handsome, quick-growing tree, with feathery foliage, distinguished by its glaucous hue; native of Mexico. Thoroughly established at the higher elevations in Ceylon and at hill stations in India, etc. Seeds small, light brown, about 6,000 = 1 oz. **C. lawsoniana.** A small pyramid-shaped evergreen tree, with crowded fine, fern-like foliage. **C. macrocarpa.** "Monterey Cypress" of California. A large, quick-growing tree, similar to **C. knightiana** but distinguished from it by its more vertical, pointed branches and darker hue. Often used for forming quick-growing and strong hedges of any size desired. Seeds black, about 2,600 = 1 oz.

C. pyramidalis (= **C. fastigiata**). A tall, somewhat erect tree, with whippy, closely adpressed branches, considered to be a variety of the following species. **C. sempervirens.** Common Cypress. A pyramid-shaped tree with horizontal branches and feathery, drooping foliage, native of S. Europe. It is especially ornamental in a young state, and thrives at high elevations. **C. torulosa.** Himalayan Cypress. Distinct, erect, rather close-foliaged tree.

Eucalyptus amygdalina. Narrow-leaved or Peppermint-Gum. *Myrtaceae.* Very tall tree of Victoria; narrow, strongly scented leaves. Said to be the tallest-growing tree in Australia. (See *Timbers*, also *Famous Trees.*)

E. citriodora. Lemon-scented Gum. A handsome tree with smooth white bark, native of Queensland. Leaves have an agreeable lemon-scented odour. (See *Essential Oils.*)

E. globulus. Blue Gum. A tall tree, commonly grown in the hills of S. India, Ceylon, etc., for fuel and wind-belts. Very conspicuous on account of the glaucous-blue colour of the young leaves; young shoots 4-angled. Thrives best between 4,000 and 6,000 ft. or higher. In Australia, its native home, it attains a great height. Prop. by the minute seed. (See *Essential Oils.*)

E. longifolia. Woolly Butt. A medium-sized tree with long, drooping branches and long, narrow leaves, resembling Weeping Willow.

Ficus macrophylla. *Moraceae.* Moreton Bay Fig. A large, spreading tree of Queensland; large leathery leaves; thrives in sheltered situations up to 6,000 ft.

Frenela (Callitris) rhomboidea. *Coniferae.* An elegant Cypress-like tree, native of Australia, introduced and acclimatised at Hakgala Gardens, Ceylon, where it bears seeds freely. Very ornamental for lawns, etc.

Gingko biloba (Salisburia adiantifolia). Maiden-hair Tree, in allusion to the crowded fern-like leaves. *Gingkoaceae.* China. A handsome tree, 30–50 ft. high, commonly planted, especially around temples, in China and Japan for ornament or for its fruit; also grown in some warm temperate countries, sometimes as an avenue or street tree. The seed, called "Pa-kwo," is eaten and relished in the Far East, being sold in the local markets. Not suited to tropical conditions. A small tree in Nuwara Eliya Park (6,000 ft.), Ceylon, has only grown to a height of some 6 ft. in about 12 years. The genus, allied to *Coniferae*, represents a very ancient type, having occurred in the Tertiary strata of England.

Gordonia anomalum. *Ternstromiaceae.* A medium-sized tree with handsome foliage, indigenous to the hill forests of Ceylon. "Very rare: I fear the extensive clearings have exterminated this fine species in most places" (Trimen).

Grevillea robusta. Silky Oak; Silver Oak. *Proteaceae.* A medium-sized or large tree of S. Australia, introduced to Ceylon in 1856, extensively planted up-country amongst Tea for shade, fuel and wind-breaks as well as for ornament. The pretty, bipinnate fern-like leaves, silvery-white beneath, render the tree very ornamental. Flowers orange-red. It does not thrive well under 1,000 ft. Wood very prettily marked, much used for furniture, etc., in Australia. Prop. by seed, which is usually best imported from its native home. (See *Shade for Crops.*)

G. barkleyana. A small, ornamental tree with large, tri-lobed or pinnatifid leaves, silvery-white underneath.

Juniperus bermudiana. Bermuda Cedar. *Coniferae.* A medium-sized tree, with leaves of two forms; thrives at elevations of 4,000–6,000 ft., and attains a height of 30–40 ft. at Hakgala Gardens, Ceylon.

Melaleuca leucadendron. *Myrtaceae.* Cajeput Tree. A large tree of Malaya, N. Australia, etc., with graceful foliage and remarkable fibrous, loose, scaly bark, which may be pulled off in large strips and is valued in native medicine. Thrives at medium to high elevations. (See *Essential Oils.*)

Pinus canariensis. *Coniferae.* Canary Island Pine. An excellent pine for high elevations in the tropics or for sub-tropical regions. In its native home, the Canary Islands, it grows from sea-level to 9,000 ft. It is being extensively planted in S. Africa, and in Chile is said to be preferred to all other pines. The wood is remarkably durable, and the tree coppices well.

P. densiflora. Japanese Pine. Long, semi-erect branches; leaves in dense bunches. Established at Nuwara Eliya, Ceylon.

P. insignis. Monterey Pine. A Californian pine-tree; thrives best at elevations of 4,000–6,000 ft.; first introduced to Ceylon in 1868.

P. longifolia. An Indian pine-tree, 60–80 ft. high, remarkable for its long, slender, pendulous leaves, which are 12–14 in. in length. Introduced at Hakgala Gardens, Ceylon, about 1885.

P. montezumae. A large handsome pine of Japan, with long spreading branches, introduced at Hakgala Gardens about 1880, and now well established there. Leaves very long, in bunches of nine.

Quercus sessiliflora. British Oak. *Cupuliferae.* This and other species of Oak may, for a time, be grown with varying success at the higher elevations in Ceylon, but seldom make good specimens. A plantation of British Oak was formed at Hakgala Gardens in 1883, from which a few fertile acorns were produced in 1892. But the trees cannot be said to be flourishing. Probably the largest Oak tree in Ceylon is at Cuddesdon, Nuwara Eliya, being nearly 60 ft. high and 8¼ ft. round the stem at 3 ft. from the ground, but even this is obviously out of its element.

·**Rhodoleia Championi.** *Hamamelideae.* A medium-sized spreading tree, with glaucous-grey foliage and bright red flowers. It is a native of Hong-kong, and has become quite established in Hakgala Gardens, Ceylon, but does not seed there.

Salix babylonica. Weeping Willow. *Salicaceae.* A medium-sized tree of Asia Minor, with handsome, drooping foliage and slender branches. Thrives at the higher elevations and in dry sub-tropical regions. Easily prop. by cuttings.

Schinus molle. *Anacardiaceae.* Pepper Tree. A small, spreading tree of ornamental habit, with handsome, drooping, fine foliage (pinnate leaves), native of sub-tropical or temperate S. America. It is best adapted to high elevations or a sub-tropical climate; bears bunches of purple berries, which are ground and used for pepper. Prefers a dry district. Prop. by seed or cuttings.

S. terebinthifolius. An ornamental small tree of Brazil, similar to the preceding species, introduced at Peradeniya in 1884.

Syncarpia laurifolia. *Myrtaceae.* Turpentine Tree of Queensland. A tall, handsome, quick-growing tree, of an erect, symmetrical habit. Yields excellent timber. Established at Hakgala Gardens, where it bears seed. Introduced to Ceylon in 1890.

Thuja orientalis. Chinese Arbor Vitae. *Coniferae.* A small, dense, bushy tree or shrub, conical in shape, with laterally flattened branchlets. China and Japan.

Tristania conferta. *Myrtaceae.* Queensland Boxwood. A tall, handsome tree, with smooth, shiny, pointed leaves, suited to the higher elevations; attains a great height in Australia. Adapted for avenues, and yields excellent timber. Seeds not fertile in Ceylon.

Widdringtonia Whytei. M'langi Cedar. *Coniferae.* A handsome pine tree, yielding valuable timber, native of the montane zone of Uganda, etc.

FLOWERING SHRUBS AND HERBACEOUS PERENNIALS

(See also pages 102–118.)

(For abbreviations, see heading to Chapter XII, p. 102.)

Abelia chinensis. *Caprifoliaceae.* Pink fls. 5–6. (C.) **A. grandiflora.** White. 5–6. (C.) **A. rupestris.** Pinkish-white. 5–6.

Abutilon insigne. *Malvaceae.* White. 4–5. **A. esculentus.** Yellow. 5–6. **A. vitifolium.** Pale blue. (C.) Numerous spp. and vars.

Allamanda Schottii. 3–5. Large, yellow, bell-shaped fls. (C. or S.)

Aloe hanburyana. *Liliaceae.* Coral-red. 1–1½. (S.) Several vars.

BOTTLE BRUSH (*Callistemon lanceolatus*).

Althaea rosea. Hollyhock. Rose-pink, etc.; very showy. See p. 128.

Anigozanthus grandiflora. *Haemadoraceae.* Australia. 2–3. Yellowish-green. (C.)

Aquilegia vulgaris and vars. Columbine. *Ranunculaceae.* Herb. perennial. 2–3. Fls. spurred, yellow, crimson, white, etc., very elegant. (S. or Div.)

Aster Amellus. Many vars. Michaelmas Daisy. *Compositae.* Hp. 2–4. Purple, blue, mauve, pink, etc. (Div.)

Azalea, different vars. *Ericaceae.* Red, pink, white, etc. 2–5. (Lay. or Div.)

Begonia fuchsioides. 3–5. Small, scarlet, drooping fls.; semi-climber. (C.) **B. bambusoides.** 6–8 ft. or more. Tall, bamboo-like stems; fls. scarlet, drooping. **B. semperflorens.** 1–2. Pink or crimson shades. Several fibrous-rooted vars. See p. 127, etc.

Bellis perennis. Daisy. *Compositae.* White or pink. ½. (Div. or S.)

Beloperone oblongata. *Acanthaceae.* Bright pink. 4–5. Brazil. (C.)

Berberis cristata. Berberry. *Berberideae.* Yellow. 3–5. **B. Fortunei.** Yellow. 4–5. China. (C. or S.)

Brunfelsia hopeana (= **B. uniflora, Franciscea bicolor**). Floriferous; blue and white (blue fls. turn white), scented. 4–5. Brazil. (C. or S.)

Calliandra Guildingii. *Mimosae.* Pink, brush-like fls.; fine pinnate lvs. 6–8. Mexico. (C. or S.)

Callistemon brachyandrus. *Myrtaceae.* Yellow. 5–6. Australia. (C. or S.) **C. lanceolatus.** Bottle Brush. Crimson. 6–8. (C. or S.)

Campanula longifolia. *Campanulaceae.* Blue. 2–3. (C. or S.) **C. medium.** Canterbury Bells. Blue, pink, and white; large bell-shaped. 2–3.

Carnations (**Dianthus caryophyllus**). *Caryophyllaceae.* White, rich shades of pink, crimson, mauve, etc. Clove-scented. ½–1. Rich, loamy soil. (C. or S.)

Cassia laevigata. *Leguminosae.* Yellow fls.; glossy lvs. 6–8. **C. Tora.** Bright yellow. 6–8. **C. venusta.** Australia. Yellow. 6–8. (S.)

Cestrum aurantiacum. *Solanaceae.* See p. 104. Free-flowering. 5–6. (C. or S.) **C. (Habrothamnus) elegans.** Crimson fls. and berries. 5–6. (C. or S.) Nat. about Hakgala and Nuwara Eliya in Ceylon.

Choisya ternata. Mexican Orange. *Rutaceae.* White, scented. 5–6. (C.)

Cestrum elegans.
Naturalised about Hill Gardens, Ceylon.

Chrysanthemum pinnatifidum. *Compositae.* White. 2½–3. **C. sinensis.** Numerous spp. and vars. White, pink, crimson, yellow, etc. 2–3. (C. or S.)
Cleome pubescens. *Capparideae.* Panama. Greenish-white, 4–5, spiny. (S. or C.)
Clianthus Dampieri. Glory Pea of New Zealand. *Leguminosae.* Beautiful flowering, straggling sh., difficult to cultivate. (C. or S.)
Cotoneaster Simonsii. *Rosaceae.* Red berries. 3–4. (C. or S.)
Cuphea jorullensis (= **C. macrophylla**). *Lythraceae.* Mexico. Orange-yellow. Young parts viscid. 2–3. (C. or Div.)
Cyphomandra fragrans. *Solanaceae.* Argentina. Pale mauve or white. 10–12. (C. or S.)
Cytisus proliferus. Tagasaste. *Leguminosae.* White. 4–6. (C. or S.) **C. canariensis.** Yellow. See *Genista.*
Datura arborea (= **Brugmansia candida**). *Solanaceae.* 8–10. Fls. pure white. 7–8 in. long. L. large, pointed. (C.) **D. chlorantha, fl. pleno.** Yellow, double fls. 6–8. **D. Knightii.** Double Trumpet-flower. Large, white, double fls. 8–12. (C.) All spp. of Datura are poisonous.
Delphinium hybridum. *Ranunculaceae.* Numerous vars.; rich shades of blue, mauve, etc. 3–5. (Div. or S.)
Digitalis canariensis. *Scrophulariaceae.* Yellow. 2–3. **D. purpurea.** Foxglove. Purple. 2–3. Not generally suited to tropics, but does fairly well up-country. (S. or Div.)
Duranta Ellisii. Duranta. White. **D. Plumieri.** Pale blue. 8–10. (C. or S.)
Embothrium speciosa. See *Telopea.*
Erica. Different spp. and vars. *Ericaceae.* Small, beautiful flowering shs., chiefly of S. Africa; thrive in loamy soil (without lime) in dry district.
Eupatorium riparium. *Compositae.* Mexico. Dull white. 5–6. (C.)
Euphorbia splendens. *Euphorbiaceae.* Madagascar. Rose-scarlet. 2–3. Bronze, thorny stems and branches, sparsely foliaged. (C.)
Franciscea bicolor. See *Brunfelsia.*
Fuchsia arborescens. Tree Fuchsia. *Onagraceae.* Mexico. Fls. lilac. 8–12. **F. corymbosa.** Peru. Scarlet fls., in long drooping clusters. 6–8. (C. or S.)
Genista canariensis. Cape Broom. *Leguminosae.* Yellow. 3–4. (C. or S.) Canary Is.

TREE FUCHSIA (*Fuchsia arborescens*).

Grevillea bipinnatifida. Australia. Bushy sh., handsome foliage. L. much cut. Fls. crimson.
Gynerium argenteum. Pampas Grass, which see.
Habrothamnus. See *Cestrum.*
Hedychium coronarium. *Scitamineae.* Hp. Pure white, scented. 4–6. **H. gardnerianum.** Similar to preceding sp. Creamy-yellow. See *Water Plants.*
Helenium, several vars. *Compositae.* Hp. 3–5. Fls. golden bronze, very ornamental. (Div.)
Heliotropium peruvianum. Heliotrope. Cherry-Pie. *Boragineae.* Different vars. White, mauve or blue shades. 3–4. Sweet scented. (C.)
Hibiscus rosa-sinensis. Shoe-flower. Numerous vars. **H. syriacus.** Small, erect sh.; bluish-purple, etc. High elevations only. See *Flowering Shrubs.*
Hydrangea hortensis. Hydrangea, which see.
Hypericum canariensis. *Hypericineae.* Yellow. 5–6. **H. mysorense.** Ceylon and S. India. Bright yellow, large showy fls. 6–8. (S. or C.)
Impatiens elongata. Bright rose-pink. 2. **I. Holstii.** Rose-pink. 1–2. **I. hookeriana.** White, veined with red. 3–4. **I. Walkeri.** Scarlet. 2–3. (C. or S.)
Indigofera decora. *Leguminosae.* Pink, drooping racemes. 1½–2. (C. or Su.) Nat. at Hakgala, Ceylon.

Jasminum pubescens. *Oleaceae.* White. 6–8. **J. revolutum.** Yellow. 6–8. **J. Sambac.** Arabian Jasmine. White. 5–6. (C.) See fig. on p. 107.
Kniphofia aloides (= **Tritoma uvaria**). Torch Lily; Red-hot Poker. *Liliaceae.* Fls. in long, scarlet or yellow, erect spikes. Very showy. 3–4. (Div.)
Lantana. Several spp. and vars. See p. 109.
Laurustinus. See *Viburnum.*
Leptospermum scoparium. *Myrtaceae.* Broom- or Tea-tree. Australia and New Zealand. Fine foliage; small white fls., in great profusion.
Libonia floribunda. *Acanthaceae.* Fls. orange. 3–5. (C.)
Lobelia cardinalis. Cardinal Flower. *Campanulaceae.* Scarlet. 3–4. (C. or S.)
Luculia gratissima. *Rubiaceae.* Ornmtl. sh., 3–4. Rose-pink, scented. (S. or C.)
Lupinus arboreus. Tree Lupin. Sh. 5–7. Blue, yellow, etc. (C. or S.)
Macleaya, see *Bocconia.*
Magnolia fuscata. Madanakam-poo, *T.* *Magnoliaceae.* Fls. cream, strongly scented. Woody sh., 6–8. **M. grandiflora.** Large sh. or small tree. Fls. large, 6–8 in. diam., pure white. (Lay.)
Melia Azedarach. Persian Lilac; Bead-tree. *Meliaceae.* Small deciduous tree with bi- or tripinnate lvs.; fls. pale lilac, in large panicles. Asia Minor.
Montanoa bipinnatifida. Tree Daisy. See *Flowering Shrubs for Low-country.*
Moraea iridioides. *Irideae.* Herb. perennial. Blue and white. 2. (Div. or S.)
Musa coccinea. Flowering Banana. Fig. on p. 180.
Nandina domestica. Fig. on p. 116.
Nierembergia gracilis. Cup Flower. *Solanaceae.* White and yellow. 2–3. (S.)
Osbeckia rubicunda. Which see.
Philadelphus coronarius. Mock Orange. *Saxifragaceae.* Creamy-white. 6–7. (C.) Commonly but wrongly called Syringa (*Syringa vulgaris* = Lilac).
Pleroma macranthum (= **Tibouchina semidecandra**). *Melastomaceae.* Large, violet-purple fls., very showy; nearly always in flower. 8–12. (C. or S.) Brazil.
Plumbago capensis. *Plumbagineae.* S. Africa. Light blue. 3–5. (C. or Div.) Prefers rather dry locality. Cut back after flowering.
Polygonum chinense. *Polygonaceae.* Creamy-white, large panicles. 6–8. (C.)
Reinwardtia trigyna. *Linaceae.* Bright yellow; fls. in small clusters. 4–5. (C.) **R. tetragyna.** Yellow. 3–4. Similar to above.

Pleroma macranthum (= *Tibouchina semidecandra*).
Large violet-purple flowers.

Rhododendron. Numerous hybrids or vars., pink, crimson, mauve, white, etc. 5–10. None of these beautiful hybrids has yet been established in Ceylon, although **R. arboreum** (*q.v.*) is indigenous.
Rubus rosaeflorus. *Rosaceae.* Dwarf sh., spreading by suckers; small, double, white, rose-like fls. (C. or Su.)
Salvia involucrata. Bright pink. Distinct. 2. **S. leucantha.** Silvery-white foliage. Purplish-blue. **S. patens.** Bright, deep blue. A beautiful plant, does best in dry locality. 2. **S. splendens.** Scarlet, very showy; free-flowering small sh. 4–5. (C. or S.)
Sparmannia africana. S. African Hemp. *Tiliaceae.* 5–8. Cordate, downy lvs.; fls. white in clusters. S. Africa. (C.)
Spiraea media. *Rosaceae.* White. 5–6. **S. peruviana.** Fls. white, double, in clusters. 5–6. (C. or Div.) See *Hedges.* Many other spp.
Stevia eupatoria. *Compositae.* Dingy white. 5–7. (C.)
Streptocarpus. Numerous spp. and vars. *Gesneraceae.* Small herb.; lilac, mauve, white, etc. ½. Chiefly S. Africa. (S.)

Streptosolen Jamesoni. Fire-bush. *Solanaceae.* Fls. bright orange-yellow, in great profusion; very showy. 4–5. Colombia. (C. or S.)

Tecoma capensis. Scarlet. 4–8. S. Africa. **T. Smithii.** Hort. Orange-red. 6–8. **T. stans.** Yellow. 10–15. (S. or C.)

Telopea (Embothrium) speciosissima. Waratah. *Proteaceae.* Beautiful flowering sh. of New S. Wales. 6–8. Fls. in large crimson spikes.

Tibouchina semidecandra. Correct name for Pleroma (or Lasiandra) macranthum. Fig. on p. 177.

Tree daisy. See *Montanoa.*

Tritoma uvaria. See *Kniphofia.*

Veronica speciosa. Other spp. and vars. *Scrophulariaceae.* Blue, purple, white, etc. 2–3. (C. or S.) New Zealand.

Viburnum Tinus. Laurustinus. *Caprifoliaceae.* White, scented. 5–7. (C.)

Vittadinia triloba. Australian Daisy. *Compositae.* Hp. White, crimson-tinted. $\frac{1}{2}$–1. (C.)

Wigandia Viegieri. *Hydrophyllaceae.* Dark blue, large fls.; large handsome lvs. 8–10. S. Amer. (C. or S.)

Yucca gloriosa. Adam's Needle. See fig. on p. 112.

Spiraea peruviana.
Flowers white, double.

FOLIAGE SHRUBS AND HERBACEOUS PERENNIALS

(See also pp. 113–118.)

Fire Bush (*Streptosolen Jamesoni.*)
A striking, free-flowering bush.

Abutilon Thompsonii. Lantern Flower. Sh. 4–5. Variegated lvs. **A. vexillarium.** L. variegated. 4–6. Fls. yellow, balloon-shaped, drooping. (C.)

Acalypha marginata. Copper Leaf. 4–6. L. coppery with pink margins. (C.)

Acanthus montanus. Hp. 3–4. L. large, oval, spiny; fls. pinkish mauve.

Agave americana variegata. American Aloe. Large succulent lvs., streaked with pale-yellow, sharp-pointed, often recurved or twisted. 6–8. (Su.) See fig. on p. 64.

Aloysia citriodora. Lemon-scented Verbena. See *Lippia.*

Anthericum liliastrum. St. Bruno's Lily. *Liliaceae.* 1–2. Long, variegated, narrow lvs. S. Africa. (Div.)

Bambusa aurea. Stems streaked yellow. **B. Fortunei variegata.** 4–6. Ornamental variegated foliage. (Su.) **B. nana.** 6–8 or more. (Div.) See *Hedges,* also *Bamboos.*

Bay laurel, see *Laurus.*

Beaucarnea longifolia. Mexico. Stem 6–10, with swollen base; long, strap-shaped lvs., like Dracaena. (S.) See p. 114.

Begonia, fibrous-rooted. Numerous spp. and vars. 3–4.

Bocconia frutescens.
A tall, handsome shrub.

Berberis Fortunei variegata. *Berberideae.* Variegated foliage. 4–5. (C.)

Bocconia (Macleaya) frutescens. John Crow Bush. *Papaveraceae.* 8–12. Large handsome, oval, pinnatifid lvs.; fls. in large, creamy-white panicles. (C. or S.) **B. cordata.** Plume Poppy. Hp. 5–7. L. very large, orbicular, palmately 5–7-lobed, dentate. Fls. in large, erect panicles, creamy-white. Stem contains yellow juice. China and Japan.

Buxus sempervirens. Boxwood. *Euphorbiaceae.* $\frac{1}{2}$–6 ft. as desired. (C.) See *Hedges.*

Cerasus lauro-cerasus. Cherry Laurel. *Rosaceae.* Glossy, oval lvs. 8–10. (C.) Suited to high elevations only.

Chlorophytum elatum. *Liliaceae.* Trop. Amer. Hp. 1–1$\frac{1}{2}$. Long, variegated, radical lvs. Suitable for edgings, etc. (Div.)

Cineraria maritima. *Compositae.* Hp. 1–1$\frac{1}{2}$. Ornamental silvery foliage; lvs. deeply cut. (S. or C.)

Cordyline australis. 15–20. Bears a crown of large, strap-shaped red or greenish lvs. Several handsome vars. New Zealand. See p. 114.

Cotyledon metallica. *Crassulaceae.* Mexico. Hp. 8–12 in. L. large, spathulate, succulent, purplish, glaucous. **C. glauca.** Mexico. 3–4 in. L. in dense rosette, glaucous, succulent. Excellent for edgings and designs, etc. Commonly known as *Echeveria.* (Off.)

Dicentra (Dielytra) spectabilis. Lyre Flower; Bleeding Heart. *Fumariaceae.* 2–3. Corolla heart-shaped, rose-purple. L. much cut. Japan. **D. eximia.** Bright pink. L. more finely cut than the above. 1. N. America.

Doryanthes Palmeri. Spear Lily. *Amaryllideae.* Large, sword-shaped, radical lvs. 6–8. Flowering stalk 15 ft. or more. Fls. dark crimson. (Su. or S.)

Dracaena arborea. Small tree, 30–40 ft. Cent. Africa.

Erigeron grandiflorus. Several vars. *Compositae.* 1$\frac{1}{2}$–2. Hp. Purple, mauve, etc. (C. or Div.)

Furcraea gigantea. See *Mauritius Hemp.*

Gunnera manicata. *Haloragaceae.* Apeape (Hawaii). Herb. stemless plant with large spreading rhizomes; lvs. very large, 5–7 ft. diam., peltate, round and pedately lobed. Requires ample moisture, as by side of a pond. S. Brazil.

Gynerium argenteum. Pampas Grass. Thrives up-country only. See p. 164.

Iresine Herbstii. *Amarantaceae.* Herb. sh. 2–3. L. crimson, with creamy-white nerves. (C.)

Pampas Grass (*Gynerium argenteum*).

Laurus nobilis. Bay Laurel. *Lauraceae.*
Leucadendron argenteum. Silver Leaf of S. Africa. *Proteaceae.* 6–10. Prized for the silvery-white, long, narrow, tomentose lvs., used as book-marks, etc. Not suited to wet regions. (S.)
Lippia. Lemon-scented Verbena. See *Perfumes.*
Melianthus major. Honey Bush. *Sapindaceae.* 3–4. L. glaucous, pinnate; fls. rich in honey. S. Africa. (C. or Div.)
Musa coccinea. Flowering Banana (*q.v.*). **M. Ensete.** Abyssinian or Tree Banana. Abyssinia. 8–12. Very large, handsome lvs.; stem stout, single. (S.)
Myrtus communis. Myrtle (*q.v.*).
Nandina domestica. Nandin (*q.v.*).
Nolina. See *Beaucarnea.*
Periwinkle. See *Vinca.*
Phormium tenax variegatum. New Zealand Flax. 5–6. L. radical, variegated, sword-shaped. (Div.) See *Fibres.*
Prunus lusitanica. Portugal Laurel. *Rosaceae.* Large evergreen sh. 6–12. (C.)
Santolina Chamaecyparissus. Cotton Lavender. Small linear lvs.; whole plant silvery-white, strongly aromatic. (C. or Div.) 1–2. See *Rockeries,* etc.

FLOWERING BANANA (*Musa coccinea*). Showing scarlet inflorescence.

Strobilanthes gossypinus. *Acanthaceae.* India. 4–5. Close bush; lvs. silvery-tomentose; very striking. (C.)
Thalictrum adiantifolium. *Ranunculaceae.* Fine Adiantum-like foliage. 2–3. (Div.)
Xanthorrhoea australis, and other spp. *Juncaceae.* Grass Tree; "Black Boy" of Australia. Curious grass-like plant with stout stem, often charred and blackened by fires, reaching a height of 10–15.

Strobilanthes gossypinus.
Foliage covered with white tomentum.

ORNAMENTAL CLIMBERS AND CREEPERS

(Indicating purposes for which specially suited. See also *Low-country Climbers,* etc.)

Abronia umbellata. Annual Creeper. *Nyctagineae.* Lilac or pink. Suitable for hanging pots. California. (C.)
Allamanda Hendersoni. Suitable for tree-trunks, fences, etc. See *Flowering Climbers.*
Ampelopsis Veitchii. Virginian Creeper. *Ampelideae.* N. Amer. Lvs. bright bronze. Walls or pillars. Suited only to cool regions. (C.)
Begonia fuchsioides. Mexico. Scarlet. Pillars, verandahs, etc. (C.)
Bignonia capreolata. N. Amer. Pink and yellow. Arbours and arches. **B. venusta.** Tanga-poo, *T.* Orange-yellow. Arbours, banks, arches, etc. (C.) See *Flowering Climbers.*
Bomarea Carderi. *Amaryllideae.* Colombia. Bright pink, spotted yellow or white; tubular, pendulous fls., in clusters. Pillars, etc. (C.)
Bougainvillea spectabilis. See *Flowering Climbers.*
Cassis viminea. W. Indies. Yellow. Trees, pillars, etc. (C.)
Clematis. Several spp. and vars. *Ranunculaceae.* Large showy fls., white, violet, blue, etc. Walls, arbours, etc. (C.)
Clianthus Dampieri. Glory Pea. See *Flowering Shrubs.*
Cobaea scandens. *Polemoniaceae.* Mexico. Large, semi-woody cl. with greenish-purple, bell-shaped fls. Suited to tall trees, fences, etc. (S. and C.)
Convolvulus, different vars. *Convolvulaceae.* Various shades. Fences, arbours, etc.
Dumasia villosa. *Leguminosae.* Nepal. Yellow. Pillars and arbours. (S. or C.)
Ecballium elaterium. Squirting Cucumber. *Cucurbitaceae.* S. Europe. Fruit 2 in. long; when ripe, on being touched, it ejects a number of seeds with fluid.
Ficus repens (= **F. stipulata**). Small ornamental foliage. Creeper on walls or trellis-work. (C.) See *Creepers for Low-country.*
Fuchsia radicans. *Onagraceae.* Brazil. Scarlet. Pillars, banks, etc. (C.)
Hardenbergia monophylla. *Leguminosae.* Australia. Blue. Hanging-pots, etc. (S. or C.)
Hedera Helix. Ivy. *Araliaceae.* Europe. Handsome foliage, lvs. usually lobed. Creeper on walls or banks. Thrives up-country. (C.)
Hibbertia dentata. *Dilleniaceae.* Australia. Yellow fls. Trees or trellises. (C.)
Hoya carnosa. Wax Flower. *Asclepiadeae.* Queensland. Pale pink, wax-like. Pillars, trellis-work, tree-trunks, etc. (C.)
Ipomoea rubro-coerulea. Mexico. Large blue, crimson-tinted. **I. Learii.** Trop. Amer. Bright purplish-blue. Trees, fences, etc. (C.) **I. versicolor.** Correct name for **Mina lobata** (*q.v.*).
Jasminum pubescens. Jasmine. White, scented. (C.) See *Flowering Climbers.*
Lapageria rosea. *Liliaceae.* Chile. Sub-tropical. White and crimson. (C.)
Lathyrus latiflorus. Perennial Pea. *Leguminosae.* Europe. Pink, etc. Fences, walls, or borders. (S. or C.)
Lippia citriodora. Lemon-scented Verbena (*q.v.*).
Lonicera caprifolia and other spp. Honeysuckle. *Caprifoliaceae.* Yellow or white fls., scented. Tree trunks, arbours, etc. **L. japonica.** Japanese Honeysuckle. Red and white, strongly scented. (C.)
Lophospermum scandens. See *Maurandia.*
Mandevilla suaveolens. *Apocynaceae.* Argentina. White, scented. Trellis-work.
Maurandia barclayana. *Scrophulariaceae.* Mexico. Violet-purple. Trellis-work, etc. (C. or S.)
Mina lobata (= **Ipomoea versicolor**). *Convolvulaceae.* Bright orange-yellow. Small, elegant cl., suited to dry districts, 4–6; fls. one-sided raceme (scorpioidal). (C. or S.)
Nasturtium. See *Tropaeolum.*
Passiflora edulis. Passion-flower. Greenish-white. See *Trop. Fruits.*
Polygonum Aubertii. *Polygonaceae.* Slender perennial cl., 20–30 ft. L. small, ovate, bronzy-red when young; fls. small, greenish-white in long, slender panicles, fragrant. China and Tibet.
Rhaphidophora decursiva (*q.v.*).

Rhyncosperma cyanosperma. *Leguminosae.* Bright red or white. Rockeries, etc.
Roses, climbing. Fences, arbours, etc. (C. or L.) See *Roses.*
Rubus (Bramble). Several spp. *Rosaceae.* Trees, fences, etc. (C. or S.)
Schmidia bicolor (= **Thunbergia wightiana**). Arbours, arches, etc. See below.
Semele (Ruscus) androgynus. *Liliaceae.* Canary Islands. Handsome foliage, no true lvs. Fls. inconspicuous. Suited to tall trees. (C.)
Senecio scandens. *Compositae.* S. Africa. White. Fences, walls, or pillars. (C.)
Smilax argyraea. *Liliaceae.* Bolivia. Variegated foliage. Trees, etc. **S. ornata.** Similar to latter; large variegated lvs. (C.)
Solandra grandiflora. *Solanaceae.* Mexico. Fls. large, trumpet-shaped, creamy-white. Suited to large trees. (C.)
Solanum jasminoides. *Solanaceae.* S. Amer. White, in large clusters, free-flowering. Fences, arbours, arches, trees, etc. (C.)
Sollya heterophylla. *Pittosporaceae.* Australia. Small bright blue fls.; small lvs. Pillars, etc.

Solandra macrantha.
Large trumpet-shaped flowers.

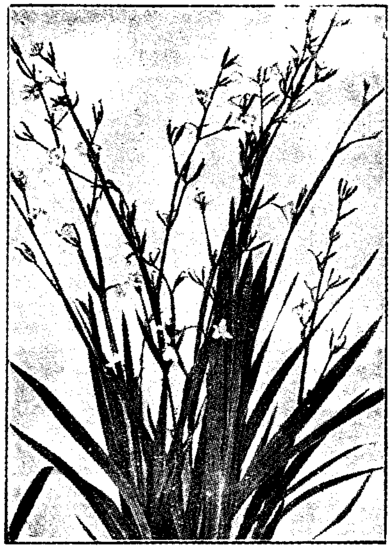
Swainsonia. Several spp. *Leguminosae.* Australia. Fine pinnate lvs. Fls. white, pink, purple, etc. (C. or S.)
Tacsonia mixta. *Passifloraceae.* Peru. Long, drooping, pink fls. Fruit yellow, ovoid, 3–4 in. long, edible. **T. quitensis.** Peru. Long, tubular, drooping, pink fls. **T. van Volxemii.** Colombia. Scarlet. Pillars, arbours, etc. (S. and C.)
Tecoma jasminoides. *Bignoniaceae.* Queensland. Waxy-pink and white fls. Pillars, arbours, etc. (C.)
Thunbergia fragrans. Ceylon. Pure white, not scented. Rockeries, etc. (S. and C.) **T. grandiflora.** (See *Climbers for Low Elevations.*) Trees and fences. **T. wightiana,** commonly known as *Schmidia bicolor.* Elegant cl.; fls. in drooping racemes, corolla yellow; bractlets large, half brown, half yellow.
Tropaeolum peregrinum. *Geraniaceae.* Ann. Bright yellow. Trellis-work, banks, etc. (S.) **T. majus.** Nasturtium. Peru. Orange-yellow. Different vars., double or single fls. Pillars, banks, rockeries, etc. (C. or S.) **T. lobbianum.** Colombia. Perennial. Scarlet. (S. or Tu.)
Vinca minor. Periwinkle. *Apocynaceae.* Europe. Fls. blue. Rockeries, hanging-pots, etc. (C.)
Wistaria sinensis. *Leguminosae.* Japan. Woody cl. Blue and purple. Verandah walls, tree-trunks, pillars, etc. (C.) Beautiful plant; thrives best under protection of a house, facing morning sun; does not flourish in a wet or hot climate.

ORNAMENTAL BULBOUS OR TUBEROUS PLANTS

Propagated by bulbs, tubers or division.

(See also pp. 130–133.)

Agapanthus umbellatus. African Lily. *Liliaceae.* Beautiful bright blue; large heads. 2–3. Also a white-flowered var. S. Africa.
Albuca aurea. *Liliaceae.* S. Africa. Greenish-yellow. 2.
Allium fragrans. *Liliaceae.* White. 1. Also numerous other spp.
Alstromeria multiflora. *Amaryllideae.* Orange-yellow. 1–2. Chile. **A. psittacina.** Crimson. 1½–2.
Amaryllis Belladonna. Belladonna Lily. *Amaryllideae.* Bright pink. 1. S. Africa.



Aristea Eckloni.
Flowers deep blue. Naturalised in Ceylon.

Antholyza bicolor. *Irideae.* Scarlet and green. 2. S. Africa.
Arisaema Leschenaultii. *Aroideae.* Cobra Lily; Wal-Kidaran, *S.* L. much cut; fls. dark purple and green, perianth recurved to form a hood. 2–3. Ceylon, India, etc.
Aristea Eckloni. *Irideae.* S. Africa. Bright blue. 1½–2. Nat. in Ceylon.
Arthropodium cirrhatum. *Liliaceae.* White. 2. New Zealand.
Arum Lily. See *Richardia.*
Begonia. Tuberous-rooted and Bedding. Numerous vars., scarlet, yellow, pink, etc. 1. See p. 127.
Belamcanda chinensis. Leopard Lily. *Irideae.* Orange-red, spotted brown. 1½–2.
Canna. See p. 131.
Clivia. See *Imantophyllum.*
Crinum asiaticum. *Amaryllideae.* Very large. 3–5. White. India, etc. **C. giganteum.** Large, white. 3–4. Trop. Africa. **C. Moorei.** Monsoon Lily. S. Africa. Large fls., delicate pink. 2–3. **C. Powelli.** 2–3. Pure white.
Crocosmia aurea (= **Tritonia aurea**).
Cyrtanthus carneus. *Amaryllideae.* S. Africa. Bright red. 1. Suitable for edging, rockeries, etc. **C. sanguineus.** Ifafa Lily. S. Africa. Fls. tubular, salmon-pink. 1. **C. Mackenii.** African Bride Lily. White. 1. Natal.
Dahlia. *Compositae.* 3–6. Double and single vars.; several types, including "Cactus," "Paeony," "Collarette," "Anemone," etc. Very showy. "Coltness Gem." Dwarf, 1, orange-scarlet, yellow, etc. **D. imperialis.**—Red or white, strong-growing sp. 6–7. Mexico.

Monsoon Lily (*Crinum Moorei*).

Dierma pulcherrima. *Irideae.* Very handsome, free-flowering; long, slender panicles, 3–4, with drooping fls., bright reddish-purple. S. Africa.
Freesia refracta. *Irideae.* Creamy-white, strongly scented. 2. S. Africa.
Gladiolus. Corn-flag. *Irideae.* S. Africa, Persia, etc. Numerous hybrids and vars.; scarlet, yellow, purple, crimson, white, etc. 2–3.
Hemerocallis aurantiaca. Golden Lily. *Liliaceae.* Bright yellow, large fls. 2½. **H. fulva.** Day Lily. Orange-yellow. 2–3. S. Amer.
Hippeastrum equestre. Knight's Star-Lily. *Amaryllideae.* Trop. Amer. Bright red, large trumpet-shaped fls. 1–1½. Different vars. and shades.
Imantophyllum (Clivia) miniata. *Amaryllideae.* Scarlet. 1–1½. S. Africa.
Iris, different vars. and types. *Irideae.* Yellow, purple, blue, etc. 2–3. Very showy, but suited to cool sub-tropical conditions only.

Ismene (Hymenocallis) calathina. Peruvian Daffodil. *Amaryllideae.* White, fragrant. 1–2. Peru.
Isoloma bogotense. *Gesneraceae.* Yellow and red. 1–1½. Trop Amer. **I. molle.** Scarlet and yellow. 1–1½. Forms runners with scale-like lvs.
Ixia pendula. *Irideae.* Fls. pink, on long, drooping, slender stalks. 2–2½. Different spp., white, crimson, yellow, etc. S. Africa.
Lachenalia aurea. *Liliaceae.* Orange-yellow. ½–¾. S. Africa.
Leucojum aestivum. Snow Flake. *Amaryllideae.* White. S. Europe.
Libertia formosa. *Irideae.* White. 1½. **L. paniculata.** White. 1½. Australia.
Lilium longiflorum. *Liliaceae.* Trumpet Lily. Large, white. 2. **L. Harrisii.** Easter or Bermuda Lily. Large, white fls. **L. auratum.** Golden-rayed Lily. White or yellow, with orange spots. 3–4. **L. candidum.** White. 2–3. Said to be the true Madonna Lily. **L. Martagon.** Turk's Cap, or Martagon Lily. Purple or lilac. 3–4. **L. nepalense.** Nepal Lily. White. 2–3. **L. tigrinum.** Tiger Lily. Orange. 2–3. Bulbs edible. China and Japan.
Lycoris aurea. *Amaryllideae.* Yellow. 1. **L. sanguinea.** Crimson. 1½. China.
Marica coerulea. *Irideae.* Blue. 2. Several other spp. S. Amer.
Montbretia. See *Tritonia.*
Moraea iridioides. *Irideae.* Blue and white, ornamental. 2. S. Africa. **M. i.** var. Johnsoni. Similar to latter, but with much larger fls.
Nerine japonica (= **Lycoris radiata**). *Amaryllideae.* Red. 1. China and Japan. **N. sarniensis.** Guernsey Lily. Crimson and rose. 1. S. Africa.
Ornithogalum nutans. Star of Bethlehem. *Liliaceae.* Palestine. White, etc. 1.
Pardanthus. See *Belamcanda.*
Phaedranassa chloracea. *Amaryllideae.* Crimson. 1. Ecuador.
Richardia (Calla) africana. Arum or Easter Lily. *Aroideae.* Large, white. 2. **R. elliottiana.** Yellow. 2. Both indigenous to S. Africa.
Sparaxis grandiflora. *Irideae.* Corn Lily. Purple, white, etc. 2. **S. tricolor.** Orange and yellow, large fls. 2. S. Africa.
Sprekelia formosissima. Jacobaea Lily. *Amaryllideae.* Deep crimson, declinate; distinct. 1½. Mexico and Guatemala.
Tigridia Pavonia. Tiger Lily. *Irideae.* Mexico. Orange-red. 1½–2½.
Tritoma uvaria. See *Kniphofia.*
Tritonia (Montbretia) crocosmaeflora. *Irideae.* Bright orange-yellow. 1½. Nat. about Hakgala and Nuwara Eliya. **T. aurea** (= **Crocosmia aurea**). Yellow and scarlet. 2. S. Africa.
Vallota purpurea. Scarborough Lily. *Amaryllideae.* Red and crimson. 1½. S. Africa.
Watsonia augusta. *Irideae.* Scarlet. 1½–2. Resembling Gladiolus. S. Africa. **W. densiflora.** White, crimson, or rose. 2. **W. rosea.** Pink. 1½–2.
Zephyranthes candida. Zephyr Lily. *Amaryllideae.* White. 1. S. Amer. **Z. carinata.** Rose Amaryllis. Bright rose. 1. **Z. tubispatha.** White. ½. **Z. Andersoni.** Crocus Lily. Yellow. ½. S. Amer.

ROSES

The fact that certain classes of the Rose, the Queen of Flowers, can be grown with considerable success, not only in the hills but at all elevations down to practically sea-level, is one of the most satisfactory features of horticulture in the tropics. They may, moreover, be cultivated to blossom almost all the year round, and though generally lacking, especially at low elevations, in size and form of bloom as well as in fragrance, in up-country gardens blooms of remarkably good quality may often be seen.

Soil and Planting. Although success largely depends on altitude, soil and climate, much may also be due to methods of cultivation as well as to selection of varieties. It is important to choose a site with full exposure to the sun, shade from trees or houses being detrimental to the plants. Protection from strong winds is necessary in the hills. The ideal soil is heavy loam on porous clay, though a light soil can be made suitable with the addition of cattle manure and, if necessary, clay. Perfect drainage at the roots is essential, and terraced beds or borders, especially in wet districts, are generally found to give the best results. These should be dug at least

2 ft. deep, returning the lower portion of the soil to the bottom and keeping the upper or surface soil towards the top, mixing with this some well-decomposed cattle manure. If the land be flat and the climate wet, the beds should be raised in the centre, so as to ensure good drainage. If the reverse is the case, the beds should be slightly sunk, so as to conserve moisture.

The plants may be spaced about 4 ft. apart each way. Young but strong plants should be chosen for planting, and it is advisable to remove any flowers that may appear early. During periods of drought a mulch of stable manure should be laid on the surface, and the plants liberally watered.

Manuring.—Roses are benefited by liberal manuring, and cattle manure, though liable to attract white ants unless in a well-decomposed state, is the best. If, however, a sprinkling of lime, vaporite, or cyllin powder is applied at the same time, this danger is obviated to a considerable extent. Castor-cake or bone meal may be given as a fertiliser at the rate of 6–8 oz. per plant. An application of liquid manure once or twice a week is also beneficial (see *Manures*). The following is a useful mixture for roses: Bone meal, 12 parts; sulphate of potash, 10 parts; sulphate of ammonia, 5 parts. This mixture may be used at the rate of 4–6 oz. per plant, and for practically all sorts of garden plants as well as roses.

Rambler Rose, "Euphrosyne."

Pruning Roses.—Modern varieties are not adapted to such severe pruning as was formerly customary, the practice now being to encourage fairly strong growth in order to induce free-flowering. A general rule is to prune according to growth—strong shoots by ⅓ their length, less strong ones by ½, and weak, thin shoots to 2 or 3 in. of the base, or even cutting them right out. Always cut just above a bud which points away from the centre of the bush, leaving the latter as open as possible. Remove dead and old wood, retaining the healthiest and strongest shoots. At low elevations, only moderate pruning should be resorted to, *i.e.* after each crop of blooms is over, the soil being forked up and manured after the operation. See *Pruning.*

Propagation.—This is invariably effected in the tropics by cuttings or layering; the plants usually thrive best on their own roots. Cuttings of well-ripened shoots may be put down in fine sandy soil at any time, except during a dry period. They should be cut with a "heel," inserted in the ground sloping-wise, and kept moist and shaded. When new growth is visible, the shade may be gradually reduced. Layering is adopted in the case of varieties which do not propagate easily by cuttings, *e.g.* "Marechal Niel," and this may be effected almost all the year round. The layered shoot is pegged down into a bamboo-joint nearly filled with fine sandy soil, the new plant being thus easily removed when it has developed sufficient roots to become independent of the parent plant, when it may be severed. Budding also, though not generally practised, may be done quite successfully in the tropics. (See *Propagation.*)

Roses in Pots or Tubs.—In the low country or hot, dry regions, roses often do better in pots or wooden tubs than in an open border, owing to unfavourable con-

ditions of soil or climate. The requirements of the plants can thus be best supplied, the tubs being filled with only the best soil and provided with efficient drainage, while they may also be moved as desired and afforded the most suitable spot in regard to light and shelter.

Diseases.—Roses are, on the whole, comparatively free from disease in the tropics, the most prevalent being mildew, "leaf spot" or "black spot," both fungus diseases. As a preventive, spray with sulphide of potassium, say ½ oz. to a gall. of water; or with diluted formalin (one table-spoonful to a gall. of soft water). See *Fungus Diseases*. Mildew sometimes attacks roses as a result of severe drought, excessive moisture at the roots, or overcrowding. Maintaining the plants in a healthy condition, as by pressing down the surface soil if too loose, covering it with a rich mulch, and by regular attention to watering in dry weather, is probably the best safeguard against diseases.

Importing Roses.—When new plants are required, they should, when practicable, be obtained from a reliable firm which specialises in these plants. If packed dry when in a dormant state, the plants take up but little space and can be transmitted in comparatively small packages by post. A good firm can be relied upon to supply good varieties. It is well to remember that roses on their own roots are often the best adapted to the tropics, also that "standard roses" are not usually suitable. Rooted cuttings travel well when their roots are wrapped in a ball of adhesive earth or clay and surrounded by moss and waterproof paper; the stems, however, must have air, or will rot in transit. When imported plants arrive, especially if the weather be dry, they should be grown in bamboo- or other pots, in the shade, for a few weeks before planting out. (See *Packing and Transport of Plants*.)

Classes.—The great majority of modern varieties come under Hybrid Teas, which are suited to practically all elevations, are free bloomers, and should blossom almost all the year round. These are mostly characterised by a delicate tea-like scent, many being delightfully fragrant. The following are a limited selection.

HYBRID TEA ROSES

Adele Crofton. Coppery-salmon.
Angele Pernet. Orange-yellow.
Avoca. Crimson, scarlet, strongly scented.
Baroness Rothschild.
Betty Uprichard. Rose-pink, scented.
Billy Boy. Yellow, semi-double.
Christine. Yellow, free bloomer.
Daily Mail. Velvety, dark crimson, scented.
Dame Edith Helen. Pink, very fragrant.
Duchess of Atholl. Coppery-pink.
Emma Wright. Orange-salmon, scented.
Etoile de Holland. Dark crimson, scented.
General McArthur. Crimson-pink, strongly scented.
Golden Emblem. Yellow.
Gorgeous. Orange-yellow.
Hugh Dickson. Crimson.
J. C. Thornton. Velvety, dark crimson.
K. of K. Semi-double. Dazzling scarlet.
La France. Lilac-pink, free bloomer, old favourite.
Lady Forteviot. Apricot-yellow.
Lady Hillingdon. Yellow.
Lady Inchiquin. Orange-cerise.
Lady Pirrie. Coppery-salmon.
Los Angeles. Salmon-rose, scented.
Mabel Morse. Pure yellow, scented.
Mdme. A. Chatanay. Salmon-rose, scented.
Mdme. Butterfly. Blush-pink, scented.
Mdme. Ed. Heriot. Coral-red, shaded yellow. "Daily Mail" the 1st.
Mrs. Henry Bowles. Rose-pink.
Mrs. Courtnay Page. Orange-cerise.
Mrs. Henry Morse. Rose-pink, scented.
Mrs. John Laing. Large bright pink, strongly scented.
Ophelia. Shell pink.
Padre. Coppery-scarlet, semi-double.
Portadown. Crimson-rose, strongly scented.
Rev. Page Roberts. Yellow, strongly scented.
Sunstar. Orange-yellow, scented.
W. E. Chapman. Deep scarlet.

SINGLE OR SEMI-DOUBLE ROSES

These are especially attractive, free bloomers, and are not liable to be affected by weather conditions. Suitable for beds and borders, and some make ideal floral hedges. Cut in the bud state, they are admirable for indoor decoration. Fls. usually in trusses.

Cecil. Golden-yellow.
Dainty Bess. Salmon-pink, scented.
Ethel James. Salmon-rose.
Irish Fireflame. Apricot-yellow, fringed orange.
Isobel. Salmon, very large blooms.
Mrs. Oakley Fisher. Apricot-yellow, scented.
Vesuvius. Dark crimson.
Zingari. Orange-scarlet.

CLIMBERS AND RAMBLERS

Suitable for arches, pillars, pergolas, walls, fences, banks, etc. They include climbing sports or varieties of Polyantha, H.T.'s, and Single Roses.

American Pillar. Carmine-pink, white eye, large trusses, very fine.
Climbing Lady Hillingdon. Deep yellow.
Dorothy Perkins. Beautiful rose-pink, double. Also a white var.
Emily Gray. Golden-yellow.
Euphrosyne. Single. Bright pink. Commonly grown on fences, etc., at the higher elevations in Ceylon, flowering profusely, especially in March–May. Fig. on p. 185.
Excelsa. Bright scarlet, double.
Hiawatha. Small fls., orange, white centre.
Marechal Niel. Pale yellow, fragrant; specially suited to low-country.
Mermaid. Yellow, single.
Nanette. White, scented.
Paul Scarlet. Vivid scarlet, semi-double. Unsurpassed.
Romeo. Deep red.
Shower of Gold. Bright yellow.
Wm. A. Richardson. Orange-yellow.

POLYANTHA ROSES

These are distinct by their small double or semi-double flowers, borne in clusters. The ordinary type is of a dwarf habit, 18–20 in. high; others larger, sometimes climbers, with individual flowers 1–1½ in. across.

Coral Cluster. Coral-pink.
Else Poulsen. Bright rose-pink.
Gloria mundi. Bright orange-scarlet.
Golden Salmon. Salmon.
Kirsten Poulsen. Bright scarlet.
Orange King. Orange.
Mary Hicks (cl.). Deep crimson.
Nurse Cavell. Crimson.
Paul Crampel. Orange-scarlet.
Sunshine. Yellow.

SHOWY ANNUALS AND BIENNIALS

Suited for Beds or Borders at Medium or High Elevations.

(See also pp. 127–130.)

(Figures indicate approximate height in feet. Propagation usually by seed, but in many cases also by cuttings.)

Procure sound seeds, preferably from reliable seedsmen in temperate countries. Sow in boxes or beds under cover; lightly cover with finely sifted soil, and water through a fine rose. When seedlings are large enough to handle, prick them out into boxes or beds under cover in good soil, 4 in. apart; pinch out the tops to induce a bushy growth. Finally, plant out when strong enough, weather permitting and according to season; shade for a few days.

Acroclinium roseum. Everlasting. *Compositae*. 1½. Rose, pink, and white vars.
Ageratum mexicanum. *Compositae*. 1–2. Blue.
Alonsoa Warscewiczii. *Scrophulariaceae*. 1½–2. Orange-red, etc. Several vars.
Alternanthera amoena. *Amarantaceae*. ½–¾. L. bronze-green or yellowish-green; several vars. Readily prop. by cuttings planted *in situ*.
Alyssum maritimum. Sweet Alyssum. *Cruciferae*. ½–¾. White, sweet scented.
Amarantus caudatus. Love-lies-bleeding. *Amarantaceae*. 2. Long, crimson, pendulous spikes. A. tricolor. Several vars. 2–3. Whole plant coppery at first, the young top lvs. becoming bright red, yellow, etc.
Ammobium alatum. Winged Everlasting. *Compositae*. 1½–2. White.
Anagallis grandiflora. Pimpernel. *Primulaceae*. ½–1. Several vars., blue, pink, crimson, lilac, white, etc.
Anchusa italica and other spp. and vars. *Boraginaceae*. 3–4. Hp. Fls. bright blue, etc.; very showy. L. mostly radical, large, hispid.
Antirrhinum majus. Snapdragon. *Scrophulariaceae*. Rich shades of orange, scarlet, crimson, pink, yellow, etc.; very showy. Tall vars. 1½ ft.; Intermediate, 1 ft.; Dwarf, 8 in.

Arctotis grandis. *Compositae.* 1½–2. Bluish-white, semi-drooping, closing in sun.
Argemone grandiflora. Evening Primrose. *Papaveraceae.* 2–3. White. Prickly glaucous lvs. Fls. open in evening. **A. mexicana.** 1–2. Yellow. L. blotched with white, spiny.
Asperula azurea. Woodruff. *Rubiaceae.* 1–1½. Light blue, scented.
Aster, China. Numerous vars., as German, Victoria, Mignon, Crown, Quilled, etc. *Compositae.* ½–1. White, pink, lilac, etc. See *Callistephus.*
Athanasia annua. Everlasting. *Compositae.* 1. Yellow. 1½–2½. S. Africa, etc.
Balsam (Impatiens). *Geraniaceae.* Numerous vars. 1–1½. White, pink, rose.
Bartonia aurea. *Gentianaceae.* 1–1½. Yellow, large fls.
Brachycome iberidifolia. Swan River Daisy. *Compositae.* 1. Blue and white vars.

Arctotis grandis.

Browallia grandiflora. *Solanaceae.* 1–2. Dark blue, large fls.
Cacalia (Emilia) coccinea. *Compositae.* 1½–2. Scarlet; stems fleshy, lvs. edible.
Calandrinia grandiflora. Rock-purslane. *Portulaceae.* ½. Pink, rose, yellow, etc.
Calceolaria hybrida. Slipper-wort. *Scrophulariaceae.* ½–1. Bright yellow.
Calendula officinalis. Pot-Marigold. Fls. double; orange, yellow. 1½. **C. pluvialis.** Cape Marigold. 1½. Lemon-yellow, double.
Callichroa (Layia) platyglossa. 1. Yellow.
Calliopsis. See *Coreopsis.*
Callirhoe digitata. Poppy Mallow. *Malvaceae.* 1. Bright magenta.
Callistephus chinensis. China Aster. 1–1½. Several vars., white, blue, purple.
Candytuft (Iberis). *Cruciferae.* 1–1½. Pure white; also crimson vars.
Centaurea Cyanus. Cornflower. *Compositae.* 1½. Rich blue, pink, etc. **C. moschata.** Sweet Sultan. 2. Purple, white, yellow.
Centranthus macrosiphon. *Valerianaceae.* 1½. Purple.
Chelone. See *Pentstemon.*
Cheiranthus Allioni. *Cruciferae.* Hybrid wallflower. Canary Is., etc. 1. Orange-yellow, showy.
Chrysanthemum coronarium. *Compositae.* 1½–2. White, with yellow centre, etc. **C. carinatum.** 1½. Tricolor vars., yellow, brown, white, etc. Very showy. **C. leucanthemum.** Ox-eye- or Shasta-daisy. 1½–2. Large, white, with yellow or brown centre. Var. **maximum** has extra large fls. **C. segatum.** Corn Marigold. 1½. Yellow, several vars. Single.
Clarkia elegans. *Onagraceae.* 2–3. Pale rose, pink, etc. **C. pulchella.** 3–5 or more. Bright rose, double, semi-climbing.
Clintonia (Dowingia) elegans. *Campanulaceae.* 1–1½. White, purple, blue, etc.
Collinsia bicolor. *Scrophulariaceae.* 1½. Purple and white.
Convolvulus. Morning Glory. Very showy, large fls. See p. 181.
Coreopsis (Calliopsis) bicolor. *Compositae.* 1–2. Yellow with brown or crimson. **C. Drummondi.** 1–2. Bright yellow. Carolina.
Cosmos bipinnatus. *Compositae.* 3–4. Pink, white; single. Light, feathery foliage. **C. sulphureus.** 3–4. Bright orange-yellow. Mexico. See *Dyes.*

Cuphea miniata. Cigar-flower. *Lythraceae.* 1–1½. Scarlet, tipped with yellow.
Delphinium cardiopetalum. Larkspur. *Ranunculaceae.* 1–2. Numerous vars., rich shades of bright blue, pink, purple, etc.; very showy.
Dianthus barbatus. Sweet William. *Caryophyllaceae.* ½–1. Shades of scarlet, crimson, pink, etc. Very ornamental. **D. caryophyllus.** Carnation. 1–1½. Shades of pink, mauve, white, etc. **D. chinensis.** Chinese- or Indian-pink. Several single and double vars. 1. White, crimson, etc.; petals large, fringed.
Erysimum perowskianum. *Cruciferae.* 1. Orange and yellow.
Eschscholzia californica. Californian Poppy. *Papaveraceae.* 1–1½. Rich orange-yellow, mauve, etc. Open in daylight. Showy.
Exacum macranthum. Large, bright blue fls. See p. 128 and fig. on p. 190.
Fumaria media. Fumitory. *Fumariaceae.* 1–2. Annual. Pink, crimson, etc.

OX-EYE DAISY (*Chrysanthemum leucanthemum* var. *maximum*).

SWEET WILLIAM (*Dianthus barbatus*).

Clarkia pulchella.

Gaillardia picta. *Compositae.* 1–2. Fls. large, yellow and crimson, very showy.
Gamolepis tagetas. *Compositae.* ½–1. Bright yellow, single fls. S. Africa.
Gaura grandiflora. *Onagraceae.* 2. White. N. Amer.
Gilia tricolor. *Polemoniaceae.* ½–1. Large, lavender or white, purple-eyed.
Godetia Whitneyi. *Onagraceae.* 1. Several vars.; pink, white, etc. Large fls.
Gypsophila elegans. *Caryophyllaceae.* 1–3. Light, feathery foliage; fls. small, greenish-white, in large loose sprays; useful for table decoration, etc.
Helianthus annuus. Sunflower. 5–6. Very large yellow fls., dark brown centre. Also dwarf vars., 3–4 ft., with smaller fls., single, bright yellow with black or brown centre; showy and useful for cut-flowers.
Helichrysum. *Compositae.* Everlasting. 2½. Yellow, orange, etc.
Iberis. See *Candytuft.*
Ipomoea rubro-coerulea. Morning Glory. 8–16. Climbers. Various shades; large, blue, purple, showy fls. See *Flowering Climbers.*
Ipomopsis (Gilia) elegans. *Polemoniaceae.* 6–8. Tubular, crimson fls.; feathery lvs.
Jacobaea elegans. See *Senecio.*
Kaulfussia (Charieis) amelloides. *Compositae.* 1–1½. Blue, crimson, and violet, daisy-like fls.
Kochia tricophylla. Summer Cypress; Burning Bush. *Chenopodiaceae.* Close, bushy, erect. 1–1½. L. pale green, filiform, turning to bronze. N. Asia.
Larkspur. See *Delphinium.*
Layia. See *Callichroa.*
Leptosiphon (Gilia) rosea. *Polemoniaceae.* 1–2. Rose-pink.
Leptosyne (Coreopsis) californica. *Compositae.* 1½. Lemon-yellow. California.
Linaria cymbalaria. *Scrophulariaceae.* ½–1. Several vars.; lilac, orange, yellow, crimson, etc.
Linum grandiflorum, var. *Linaceae.* 1½. Several vars.; scarlet, blue, etc.
Lobelia erinus. *Campanulaceae.* ½. Several vars.; blue, purple, and white.
Lupinus polyphyllus. Lupin. *Leguminosae.* 2–3. Numerous vars.; erect spikes; shades of blue, pink, yellow, etc.; very showy.
Malcolmia maritima. Virginian Stock.
Malope grandiflora. *Malvaceae.* 2–3. Large fls. crimson, etc., white-striped.

Exacum macranthum.
A beautiful annual of Ceylon. Flowers large, deep blue.

Marigold, African (Tagetes erecta). *Compositae.* 2–3. Bright lemon-yellow, orange, etc. **M., Corn (Chrysanthemum segatum).** **M., French (Tagetes patula).** Samie-poo, *T.* 1–1½. Orange, yellow, and crimson vars.
Mathiola annua. See *Stocks.*
Mesembryanthemum tricolor. Fig-marigold. *Ficoideae.* ½–1. Many other spp., pink, white, etc.
Mignonette (Reseda odorata). *Resedaceae.* 1–1½. Greenish-white or cream, sweet scented.
Mimulus maculosus. Monkey Flower. *Scrophulariaceae.* ½–1. Fls. pale yellow, blotched with brown.
Mirabilis Jalapa. Marvel of Peru; Four-o'clock Flower; Sendrikka, *S.* *Nyctagineae.* 1½–2. Rose-pink, white, etc.
Myosotis palustris. Forget-me-not. *Boraginaceae.* ½–1. Blue or pink. Several vars.

Nasturtium. See *Tropaeolum.*
Nemesia strumosa. *Scrophulariaceae.* ½–1. White, crimson, etc. California.
Nemophila insignis. *Hydrophyllaceae.* ½. Blue, white, and purple-margined.
Nicotiana affinis. Flowering Tobacco. 2–3. Several vars.; white, purple, pink, etc. **N. Sanderii.** Fine strain; different shades; 2–3.
Nierembergia frutescens. *Solanaceae.* 1½. Blue, funnel-shaped.
Nigella damascena. Fennel-flower; Love-in-a-Mist. *Ranunculaceae.* 1–1½. Fls. pale to deep blue; fine feathery foliage. Very attractive.
Nolana grandiflora. *Nolanaceae.* ½–1. White and blue, bell-shaped; trailing habit.
Nycterinia selaginoides. *Scrophulariaceae.* ½–¾. Pink. S. Africa.
Oenothera biennis. Evening Primrose. *Onagraceae.* 1–1½. Large, bright yellow fls., opening in evening. Semi-nat. near up-country gardens, Ceylon.
Pansy (Viola tricolor). *Violaceae.* ½. Numerous vars. Large fls., very showy, violet, blue, yellow and white. See p. 192.
Papaver. See *Poppy.*
Pentstemon. *Scrophulariaceae.* 2–3. Numerous spp. and vars.; crimson, pink, rosy-purple, etc. See *Chelone.*
Petunia, single and double vars. *Solanaceae.* 1½–2. White, purple and striped; large showy fls. Single vars. excellent for bedding, etc. See *Pot Plants.*
Phacelia campanularia. Californian Bluebell. *Hydrophyllaceae.* 1½–2. Bright blue; several vars.
Philydrum lanuginosum. *Philydraceae.* 2–3. Yellow.
Phlox Drummondi. *Polemoniaceae.* 1. Numerous showy vars.; white, scarlet, purple, crimson; "Star" and "Fringed" vars.

Love-in-a-Mist (*Nigella damascena*).
Flowers pale to deep blue.

Pimpinella monoica. Lady's Lace. *Umbelliferae.* Ann. 2–4. Fls. small, white, in large, loose sprays. Very graceful, excellent for bouquets. India.
Platystemon californicus. *Papaveraceae.* 1. Bright lemon-yellow.
Poppy, Shirley (Papaver Rhoeas). *Papaveraceae.* 2–3. Different shades; scarlet, purple, white, etc. Very showy.
Portulaca grandiflora. Sun-plant. *Portulaceae.* ¼. Different brilliant shades.
Pyrethrum aureum. Golden Feather. *Compositae.* ½–¾. Ornamental, yellow, feathery foliage.
Reseda. See *Mignonette.*
Rhodanthe Manglesii. Everlasting. *Compositae.* 1–1½. Rosy-purple, etc.
Salpiglossis coccinea. Numerous vars. *Solanaceae.* 2. Combined shades of scarlet, blue, purple, etc.
Salvia. Different spp. and vars.; scarlet, blue, purple, pink, etc. See p. 129.
Saponaria calabrica. Soapwort. *Caryophyllaceae.* 1. Bright pink.
Scabiosa caucasica. *Dipsaceae.* 2–3. Large, showy, blue, mauve, etc.

Schizanthus pinnatus. Fringe-flower. *Scrophulariaceae.* 1½–2. Purple, etc.
Sedum. Stone-crop. *Crassulaceae.* Numerous spp. ½. Yellow, white, purple.
Senecio elegans. Purple Jacobaea. *Compositae.* 1½. Crimson, purple, white, etc.
Silene pendula. Catch Fly. *Caryophyllaceae.* 1½. Carmine; single and double vars.
Spartium junceum. Spanish Broom. *Leguminosae.* 2–3. Showy yellow fls.
Sphenogyne speciosa. Several vars. *Compositae.* 1. Yellow, crimson, white, etc.
Statice sinuata. Sea Lavender. *Plumbagineae.* 1–1½. L. sinuate, basal; fls. yellow, purple. S. Suworowi. 1½. Long branching spike, rose-pink. S. Africa.
Stocks (Mathiola). Ten Weeks, East Lothian, and Virginian. *Cruciferae.* 1½–2. White, purple, etc., scented; "Single" and "Double" vars.
Sunflower. See *Helianthus.*
Sweet Peas (Lathyrus odoratus). *Leguminosae.* Ann. twiners. 5–6. Numerous beautiful shades and vars. Thrives from 4,000 ft. upwards. Sow seeds 3–4 in. apart in a double or treble row, in well-manured trench. One pound seed should sow about 150 feet of double row, or 100 feet treble row. "Eckford" and "Spencer" vars. are well known.

Schizanthus pinnatus.

Sweet William. See *Dianthus barbatus.*
Tobacco, Flowering. See *Nicotiana.*
Torenia Fourneri. *Scrophulariaceae.* ½. Purple, pale blue and white. Also a white-flowered var. **T. bailloni.** ½–1. Yellow, semi-trailing.
Trachelium coeruleum. *Campanulaceae.* 1–1½. Blue.
Tropaeolum majus. Nasturtium. *Geraniaceae.* 6–10. Herb. cl.; orange, yellow, etc. **T. atrosanguineum.** Dwarf Nasturtium. Several vars. 8–12 in. Orange, yellow, etc.
Ursinia pulchra. *Compositae.* 1–2. L. much cut; fls. orange-yellow, 2 in. across. **U. anethoides.** Orange, dark centre, showy. S. Africa.
Venidium fastuosum. *Compositae.* 2. L. fleshy, villous; fls. large, orange-yellow. (S.)
Verbena. *Verbenaceae.* 1. Numerous vars.; white, scarlet, purple, etc. **V. bonariensis.** Bright purple. L. deeply cut. Nat. near up-country gardens, Ceylon.
Viola. See *Pansy.* Viola differs from Pansy in being self-coloured (not variegated) and having usually smaller flowers. ½; large showy fls., blue, yellow, etc. Excellent for edging.
Violet (Viola odorata). ½. Blue, purple, white.
Whitlavia (Phacelia) grandiflora. *Hydrophyllaceae.* 3–4. Violet-purple.
Xeranthemum annuum. Everlasting. *Compositae.* 1–1½. Different vars.; rose, white, violet, etc.
Zinnia. 1½–2. Different vars.; scarlet, pink, yellow. **Z. haageana (Z. linearis).** 1. Orange-yellow, single; wiry, slender stems. See p. 130.

SELECTED POT-PLANTS

Suitable for High Elevations. (See also pp. 75, 142, 147.)

Many of the foregoing up-country selections are adapted for pot-culture at medium to high elevations, and in addition to these the following may be mentioned as being especially suited for the purpose. With, however, the protection of a greenhouse or a glazed and well-lighted verandah, palms and many other choice plants of lower elevations which without such artificial protection would not thrive much above 3,500 ft., can sometimes be grown in the hills with success. The limit of elevation in Ceylon, under natural conditions, for the successful cultivation of purely tropical palms may be said to be about 3,000 ft., or 4,000 ft. in sheltered localities. Palms of sub-tropical regions will, however, flourish at the higher altitudes, but are unsuited to low elevations. (See *Sub-tropical Palms.*) The following selection of plants for pot-culture at the higher elevations is, of course, capable of considerable extension.

Cineraria webberiana. Garden hybrid.

Achimenes. Small, tuberous-rooted, free-flowering, herbaceous plants. Very showy. Easily grown; prefers light, porous rich soil. (S. or Tu.) (See p. 130.)
Asparagus decumbens (= **A. crispus**). S. Africa. 12–15 in.; elegant feathery foliage. (S. or Tu.)
Aspidistra lurida variegata. *Liliaceae.* Japan. Hardy, stemless plant, 2 ft.; large, handsome, white-striped, radical leaves. Rich loamy soil. (Div.)
Azalea indica. Small slow-growing shrubs, bearing a profusion of large, pink, white, or yellow flowers. Numerous, very showy, single and double varieties.
Begonia, fibrous-rooted. Numerous varieties, showy flowers or foliage.
B. tuberous-rooted. Very large, brilliant yellow or scarlet flowers.
B. rex. About 10–12 in. high. Large, beautifully marked, ornamental leaves. Numerous varieties. See *Pot Plants for Low-country.*
Chrysanthemum, Japanese. One of the most beautiful genera of flowering plants. Numerous varieties, white, yellow and pink shades. (See pp. 128, 188.)
Cineraria. A genus of showy flowering plants, 1½–2 ft., bearing large heads of rich blue, purplish or crimson flowers; large, roundish leaves. Grown as ann. Thrive in rich loamy soil with abundant moisture. (S.)
Coleus. Ann. Beautifully marked, soft velvety lvs.; easily prop. by cuttings. Rich loamy soil, abundant manure and moisture. (See p. 128.)
Cyclamen. Small tuberous plants with pretty, delicate pink, crimson or white flowers; suited for growing under cover at the higher elevations.
Dracaena (Cordyline). Handsome palm-like plants, with long, bronze, crimson, or green lvs. Numerous vars. (See pp. 115, 145.)
Epiphyllum. *Cactaceae.* Succulent, leafless plants, 2–3; very showy, bright pink or crimson fls. Numerous species and vars. (C.)

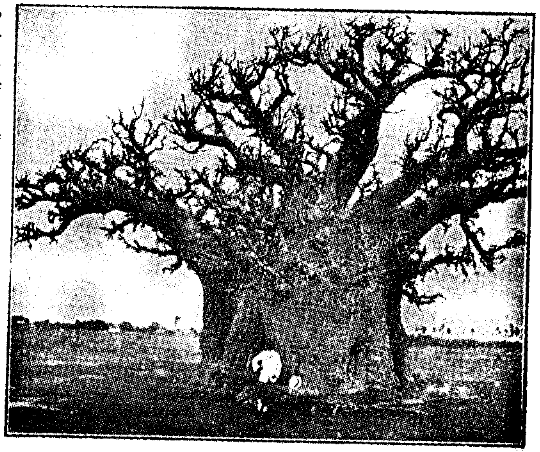
Ferns. See *Ferns.*
Francoa ramosa. *Saxifragaceae.* An ornamental creeping plant, suitable for hanging-pots. (Div. or C.)
Freesia. Small tuberous plants, producing a profusion of creamy-white, scented flowers, 1½–2. They require a cool atmosphere and protection from the rains. Best grown under cover. (See *Bulbs and Tubers.*)
Fuchsia. Beautiful flowering small shrubs; numerous vars. Prop. by cuttings, sometimes from seed. Rich, loamy soil.
Genista. Small free-flowering shrubs with yellow or white blossoms.
Geranium (Pelargonium). *Geraniaceae.* A universal favourite. Numerous varieties; flowers of many shades, very showy; leaves fragrant. With care, the plants thrive for a time at medium as well as high elevations, but require frequent pruning, partial shade, and protection from excessive rain and wind. They are much benefited by a weak application of a fertiliser in solution with water. Rich loamy soil. **G. Zonal,** or **Tricolor.** Leaves prettily marked, greenish-yellow and brown, horseshoe shaped, fragrant. **G. Ivy-leaved.** Showy and free-flowering, suitable for training on pillars, sunny banks, hanging-pots, etc. Leaves shiny, angular. Prop. by cuttings.
Gesnera. Small, tuberous, showy flowering plants. Numerous species and varieties. **G. Douglasi** and **G. magnifica** are especially attractive.
Gloxinia. *Gesneraceae.* Tuberous-rooted small plants, exceedingly showy when in bloom. Large, bell-shaped flowers; different shades: white, pink, crimson, etc. Rich, humous soil and partial shade. (S.)
Hydrangea. Small shrubs, producing large round heads of blue, pink, or white flowers, chiefly from March to July. A sheltered border with rich loamy soil suits them best, a deficiency of lime being considered to encourage the production of deep blue flowers. Sulphate of iron in solution (1 oz. per gall. of water) given once a week before flowering also produces blue flowers, and a preparation known as *Cyanol* is supplied by the trade for this purpose. Cut back and re-pot after flowering, or, if in the ground, fork up and manure the soil.
Impatiens. Showy herbaceous flowering plants, 1–3 ft. Among the best are: **I. Holstii, I. Sultani,** and **I. fasciculata.** (See p. 148.)
Pelargonium. A class of beautiful, bushy plants with scented, curly or cut leaves and showy flowers, allied to Geraniums. *Pelargonium* is the botanical name for the "Geranium" of gardens. Prefers rich, loamy soil, and a rather dry, sheltered locality. Prop. by cuttings.
Petunia. Very showy genus of flowering annuals, blooming freely and continuously. Single, double, and fringed varieties. Rich loamy soil suits them best. Prop. by seed or cuttings. (See p. 191.)
Primula chinensis. *Primulaceae.* Small herbaceous, flowering annuals; numerous varieties. Prefer rich loamy soil. (Div. or S.)
P. obconica. Small perennial herb, flowering in the cold season. Flowers pink or white. (S. or Div.)
Spiraea (Hoteia) japonica. *Rosaceae.* A popular plant for pot-culture; flowers creamy-white, in large, erect panicles. Loamy soil. (Div. or S.)
Streptocarpus. *Gesneraceae.* Perennial herb with prostrate leaves, bearing erect scapes of large bluish or lilac flowers. Several species and hybrids. (S.)
Violets (Viola odorata). *Violaceae.* Several single- and double-flowered varieties, grown successfully in sheltered but sunny and well drained borders, or in rockeries, pots or boxes, with rich, humous soil. Among the best are: *Double varieties:* "Neapolitan," pale lavender, very sweet-scented; "Comte de Brazza," white flowers; "Marie Louise," "Lady Hume Campbell," "Mrs. Astor." *Single varieties:* "La France," "Prince of Wales," "Admiral Avellan." (See *Viola* and *Pansy.*)

CHAPTER XVI

SELECTIONS FOR SEA-COAST OR MODERATELY DRY REGIONS

1. *ORNAMENTAL OR USEFUL TREES.*
2. *ORNAMENTAL SHRUBS.*
3. *ORNAMENTAL CLIMBERS OR CREEPERS.*
4. *SAND-BINDING PLANTS.*
5. *PLANTS FOR BANK-BINDING.*
6. *PLANTS OR TREES FOR SWAMPY SITUATIONS:—*
   (A) *FOR LOW ELEVATIONS.*
   (B) *FOR UP-COUNTRY.*

Although the majority of plants or trees are naturally suited to a moist humid climate, certain species are partial to the sea-coast and are botanically referred to as *halophytes.* Others are naturally adapted to dry arid localities (*xerophytes*), and generally fail to thrive when removed to a moist climate, *e.g.* Palmyra palm, Date palm, Baobab-tree, etc. With irrigation, however, many kinds, including certain food and fruit crops, which are normally suited to a moist climate may be found to thrive with some degree of perfection in regions with a very limited rainfall. (See pp. 1 and 206.)



Baobab Tree (*Adansonia digitata*). At Jaffna, Ceylon. Remarkable for its great age and stout trunk.

ORNAMENTAL OR USEFUL TREES

(See also pp. 79–101. For abbreviations see p. 102.)

Acacia arabica. Karuwel, *T*; Babul (India). A small tree or sh., common in drier parts of Eastern Trop. (See *Gums.*) **A. leucophloea.** Maha-andara, *S*; Velvel, *T*. Large tree with spreading branches and pale yellow fls. Heart-wood hard and durable. **A. planifrons.** Odai or Udai, *T*; Umbrella Tree. A small ornamental tree with erect stem and umbrella-shaped head (branches spreading in a plane), and very small lvs.; native of N. Ceylon and S. India.
Adansonia digitata. Baobab Tree; Tebeldi; Purunku, *T*. *Bombaceae.* A low-spreading, remarkable tree, native of drier parts of Cent. Africa, famous for the great age and girth to which it attains. See *Remarkable Trees.* A few trees have long been established and annually bear fruit in the dry northern part of Ceylon, where they were introduced by Arab traders. It is also grown in parts

of India. The tree in its native home thrives naturally in almost desert areas; the trunk with age becomes decayed and hollowed out in the centre, forming a storage for water, sometimes holding as much as 250 gallons. It is supposed to be one of the longest-lived trees in the world. Wood soft and spongy; inner bark fibrous. The white gourd-like fruits are spongy, farinaceous, acid and edible. **A. Gregori.** Australian Baobab or Gouty-stem Tree. The dry acidulous pulp of the fruit is eaten by the Australian aborigines.

Albizzia Lebbek. Sirrus; Mara, *S*; Vahai, *T*. Large tree with fine foliage, native of Trop. Asia and Africa, often planted for shade. Excellent brown timber; does not readily warp. (See p. 203.) **A. odoratissima.** Suriya-mara, *S*; Ponnaimurankai, *T*. Large tree, with white, scented fls. Heartwood very hard, dark brown.

Azadirachta indica. Neem- or Nim-tree; Margosa; Kohomba, *S*. A tall, erect tree with long branches and small pinnate lvs. Fls. white, scented. A much valued tree in India, Ceylon, etc. See *Native Drugs*, etc.

Barringtonia speciosa and **B. racemosa.** Mudilla, *S*. (*q.v.*).

Bauhinia tomentosa. Petan, or Kaha-petan, *S*; Tiruvatti, *T*. A small tree or large sh., with slender branches and yellow fls. Heartwood hard, dark red, tough.

Berrya ammonilla. Trincomalee-wood; Halmilla, *S*; Chavandalai, *T*. A large, erect, handsome tree; valuable timber. See *Timbers*.

Borassus flabellifer. Palmyra Palm. See *Sugar Palms*, etc.

Caesalpinia coriaria. Divi-divi. A spreading, medium-sized tree, with fine feathery lvs., producing greenish-white, strongly scented fls. See *Tans*, etc.

Carallia integerrima. Dawata, *S* (see p. 209.)

Cassia Fistula. Indian Laburnum; Ehela, *S*. See *Flowering Trees*. **C. marginata.** Ratu-wa, *S*, Vakai, *T*, and **C. multijuga.** See p. 82.

Casuarina equisetifolia. Beef-wood; Kana-gaha, *S*. Several other spp. (*q.v.*).

Cerbera Odollam. Gon-kaduru, *S*. *Apocynaceae*. Small tree, about 30 ft. high; fls. white, scented. Chiefly sea-coast.

Cochlospermum gossypium. Kinihiriya, *S*. See *Flowering Trees*.

Cocos nucifera. Coconut Palm (*q.v.*).

Diospyros Embryopteris. Timbiri, *S*. A moderate-sized, evergreen, symmetrical tree with handsome foliage and spreading branches.

Dodonea viscosa. Sanatta (India); Pichon (W. Indies). A small, evergreen, dioecious tree, with fine twiggy foliage; young parts viscid. Prop. from seed. See p. 203.

Eucalyptus alba. White Gum. A tall, slim tree with smooth, pale grey bark, 70–80 ft. or taller. See *Orn. Fol. Trees*. **E. citriodora.** Lemon-scented Gum Tree. Handsome slender tree, 40–50 ft. **E. calophylla.** Stringy Bark. W. Australia. Tall tree, excellent timber.

Ficus Benjamina. Java Willow. See *Orn. Fol. Trees*.

Holoptelea integrifolia. Indian Elm; Goda-kirilla, *S*; Velayil, *T*. A tree with handsome drooping branches, 50–60 ft. high; good timber.

Leucaena glauca. Wild- or Horse-tamarind. A small, quick-growing leguminous tree, 15–20 ft. high, with small bipinnate lvs., suited to dry or wet districts. Sometimes used as shade for field crops, affording light shade. It may, however, become a weed in cultivated ground if neglected. Furnishes good fuel. Foliage relished by cattle. Seeds abundant and hard. See *Green Manures*, etc.

Millingtonia hortensis. Indian Cork Tree. See *Flowering Trees*.

Mischodon zeylanicus. Tammana, *S*; Tampanai, *T*. A tree 30–40 ft. high, with long lanceolate lvs.; young foliage bright pink. Excellent timber.

Murraya exotica, var. buxifolia. Etteriya, *S*. A small graceful tree or large sh., with small lvs.; fls. pure white and sweet-scented.

Ochrosia borbonica. Mudu-kaduru, *S*. *Apocynaceae*. Small tree, 25–30 ft. Sea-coast; large ornamental lvs.; small greenish-white fls.

Peltophorum ferrugineum. Iya-vakai, *T*. See *Flowering Trees*.

Persea (Alseodaphne) semecarpifolia. We-warani, *S*; Ranai or Yavaranai, *T*. A large, much-branched tree, common to dry region. See *Timbers*.

Pisonia alba. Lettuce Tree. See *Orn. Fol. Trees*.

Pithecolobium (Inga) Saman. Rain-tree. See *Fol. Trees, Shade Trees*, etc. With good soil it thrives in a moderately dry district, where it is more suitable as a permanent road-side tree than in wet districts, as in the latter it grows rapidly to a great size and develops a shallow rooting system. **P. dulce.** Madras Thorn. 40–50 ft. See *Hedges, Shade Trees*, etc.

Plumeria acutifolia. Temple Tree. See *Orn. Fol. Trees*.

Poinciana regia. Flamboyante. See *Flowering Trees*. Thrives in dry, hot climates if planted in deep soil.

Polyalthia longifolia. Mara-illupai, *T*. See p. 210.

Spathodea campanulata. See *Flowering Trees*.

Swietenia Mahagoni. Mahogany. See *Orn. Fol. Trees*, also *Timbers*, etc.

Tamarindus indica. Tamarind; Siyambala, *S*. A large, handsome, spreading, symmetrical tree with small pinnate lvs., specially adapted for road-sides, particularly in dry districts. Beautiful red timber. See *Orn. Fol. Trees*, etc.

Thespesia populnea. Tulip Tree; Suriya, *S*; Kavarachu, *T*. *Malvaceae*. A small, evergreen, spreading tree with yellow, funnel-shaped fls.; specially suited to sea-coast. Good timber.

Vitex altissima. Milla, or Sapu-milla, *S*; Kadamanakku, *T*. Large tree with a dense head and somewhat drooping branches. See *Timber Trees*. **V. leucoxylon.** Nebedda, *S*; Kaddunochchi, *T*. Large tree with a spreading head, common in dry region, especially near tanks. Valuable timber.

Cryptostegia grandiflora.

ORNAMENTAL SHRUBS

(See also pp. 102–118.)

Acalypha, different vars. Brightly coloured lvs.

Agave americana variegata. American Aloe. See *Succulent Plants*.

Aralia filicifolia. Young foliage yellow, feathery, and very handsome.

Arundo Donax variegata, which see.

Asystasia coromandeliana. Puruk, *S*; Peyppatchotti, *T*.

Caesalpinia pulcherrima. Peacock Flower. 5–6. Fls. bright yellow or scarlet.

Carissa Carandas. Maha-karamba, *S*; Perunkila, *T*. See *Trop. Fruits*.

Clerodendron inerme. Wal-gurenda, *S*; Pinari, *T*.

Croton (= **Codiaeum**). Numerous vars. Brightly coloured foliage.

Cryptostegia grandiflora. *Apocynaceae*. Climbing sh.; showy magenta fls. (C.) Trop. Africa.

Dombeya angulata. Spreading sh.; fls. pink, in drooping bunches.

Hibiscus. Shoe-flower. Numerous vars.

Ixora. Different spp. and vars. Pink, yellow, scarlet, etc. (C.)

Lagerstroemia indica. Indian Lilac; Crepe Myrtle. Specially suited to sea-coast.

Nerium Oleander. Oleander. A beautiful free-flowering sh. Specially suited to sea-coast and dry sub-tropics. See pp. 110, 205.

Panax fruticosum. 5–6. Evergreen; lvs. much cut, ornamental. (C.)

Pandanus odoratissimus. Screw-pine; Mudu-keyiya, *S*; Talai, *T*. 15–20. Fruit globose or oblong, red when ripe. (Su. or S.)

Pavetta indica. Pawatta, *S*; Pavaddai, *T*. Bears profusion of white fls. (C.)

Punica granatum. Pomegranate; Delun, *S*. Beautiful large scarlet fls. Specially suited to dry region. See *Trop. Fruits*, etc.

Scaevola Koenigii. Takkada, *S*. *Goodenoviaceae*. See *Pith Trees*. (C. or S.)

Sophora tomentosa. Mudu-murunga, *S*. L. covered with soft, grey tomentum.

Tamarix. Several spp., mostly leafless shs., resembling Casuarina, found in dry regions or sandy sea-coast. See p. 204, etc.

Turnera ulmifolia. 2–3. Fls. yellow. See p. 130, etc.

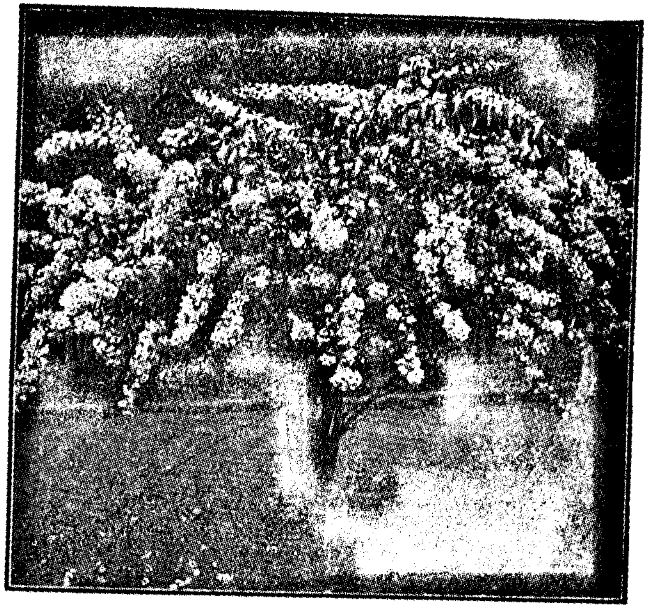
Vinca rosea. Madagascar Periwinkle. 2. Fls. rose-pink, white, or white w th red centre. (C. or S.)

Wrightia zeylanica. Sudhu- or Wal-idda, *S.* See *Flowering Shrubs.*
Yucca gloriosa. Spanish Bayonet. See fig. on p. 112.

ORNAMENTAL CLIMBERS

(See also pp. 118–123.)

Allamanda Hendersoni. Large, yellow, bell-shaped fls. L. usually in whorls.
Antigonon leptopus, which see. Slender stems; lovely pink fls.
Argyreia speciosa. Maha-dumudu, *S.* *Convolvulaceae.* Large, handsome lvs., snowy-white beneath; fls. large, purple. Strong grower. (C. or S.)
Bignonia Unguis. Slender creeper; yellow, bell-shaped fls.; very beautiful when in full blossom. (S. or Su.)
Bougainvillea. Several spp. and vars. See *Flowering Climbers*, p. 119.



Bougainvillea formosa.
Beautiful pinkish-purple blossom. See p. 119.

Clerodendron Thomsonae. Fls. white and scarlet. (C. or S.)
Ipomoea Bona-nox. Moon Flower; Kalu-alanga, *S.* **I. Briggsii.** Bright crimson, small fls.; very showy, free bloomer. (C.) **I. carnea.** Fls. large, pale pink. (C.) **I. muricata.** Alanga, *S.* Fls. edible.
Porana volubilis. Bridal Bouquet. See *Flowering Climbers.*
Quisqualis indica. Rangoon Creeper, which see.
Tecoma capensis. Fls. scarlet; slow grower, 6–8 ft.
Thunbergia grandiflora. Large, robust climber; fls. large, blue; tuberous roots.
Tristellateia australis. Fls. in erect yellow racemes.

SAND-BINDING PLANTS

Where it is desired to check sand-drifting on sea-coasts, or reclaim wind-swept areas, as in arid localities, it is necessary at first to establish deep-rooting or salt-resisting species. These should be such as are un-

attractive to browsing stock and are of fairly rapid growth, with ascending stems so as to prevent their being choked and buried by drifting sand. The Marram-grass (*Ammophila arenaria*) has been introduced into Australia and other warm countries for this purpose with excellent results. It is practically of no nutritive value to stock, owing to its coarse silicated leaves, and is propagated by roots, being usually planted in rows 2–3 ft. apart, at right angles to the prevailing wind.

Such plants have not only valuable sand-binding properties, by which they prevent erosion and shifting sand-banks, but also form by their humus a foundation for the establishment of more useful species. The following are among those specially adapted to sandy areas near the sea.

Barringtonia racemosa. Mudilla, *S.* A small tree with drooping branches, common near the sea-shore in Ceylon.
Calotropis gigantea. Wara, *S.* (*Compositae.*) A large glaucous sh. with oblong lvs.; common near sea-coast. See *Fibres.*
Canavalia obtusifolia. Mudu-awara, *S.* A creeping leguminous perennial, with bright pink or white fls. Grows luxuriantly on sandy sea-shores.
Cassia auriculata. Ranawara, *S.* A large sh., 6–8 ft., with spreading branches and bright yellow fls. The dried lvs. form the Matara Tea of Ceylon, which see. Lvs. and young pods edible.
Ipomoea biloba. Mudu Bin-tamburu, *S.* A creeping herb with bright purplish-rose fls. and fleshy lvs.; common on sea-shore sand along the south and west coast of Ceylon.
Pandanus odoratissimus. Screw Pine. A spreading bush with numerous aerial shoots, which descend and fix the plant in the sand. See p. 197.
Scaevola Koenigii. Takkada, *S.* A large spreading bush, with creamy-white fls. and pithy stems; common on south-west coast of Ceylon.
Spinifex squarrosus. Water Pink; Maharawana-rewula, *S.* A greyish glaucous grass which grows in broad tufts on sandy shores; cultivated on the Madras coast for its sand-binding properties. Several other spp. in warm countries.
Tamarix gallica and other spp. Tamarisk; Kiri, *T.* *Tamaricaceae.* Large shs. or small trees with small scale-like lvs., specially adapted to sandy sea-shores (*q.v.*).
Tephrosia purpurea. Pila, *S.* A leguminous perennial, 1–2 ft. high; fls. small, purplish-pink. See *Green Manures.*

PLANTS FOR RAILWAY BANKS, ETC.

In addition to possessing the quality of binding loose banks, etc., some plants may also afford valuable fodder for cattle. Thus at low elevations both purposes may be served by the Guinea-grass (*P. maximum*), Love-grass or Tutteri, *S* (*Chrysopogon aciculatus*) and Etora, *S* (*Panicum repens*); while in drier localities the Doob-grass or Arugam-pillu, *T* (*Cynodon Dactylon*) and species of *Desmodium* have similar effects. *Cassia mimosoides* and the Sensitive-plant (*Mimosa pudica*) have useful binding qualities on loose sandy soils at low elevations, but are unsuitable for fodder. At elevations of 4,000–6,000 ft., *Paspalum dilatatum* (Golden Crown grass) is an excellent plant for binding railway banks, etc., while it is also one of the best fodder plants for up-country. (See *Fodder Grasses*, etc.)

TREES, ETC., SUITED TO SWAMPY SITUATIONS

(See also *Water Plants.*)

Though some trees and shrubs are adapted to wet or swampy localities, as along water margins or in land occasionally submerged, very few, if any, will thrive in land saturated or covered with stagnant water. Therefore, when it is desired to plant up a swamp with a view to draining

the land, it is essential that the conditions should first be made suitable for plant-growth. Where this is not already the case, as by reason of stagnant or brackish water, drainage must be resorted to in order to draw off the latter. Deep channels should be cut, outlets made for the water to escape, the earth being thrown up in ridges and a liberal application of freshly-slaked lime given. By this means moisture-loving trees or even certain crops may be established which will in time effect or aid the desired object. The following selection is recommended for such conditions :

(A) FOR LOW-COUNTRY:

Anacardium occidentale. Cashew-nut.
Anona palustris. Pond-apple.
Barringtonia speciosa. Mudilla, *S.* (T.)
Carludovica palmata. Panama-hat plant.
Casuarina equisetifolia, and other spp.
Cerbera Odollam. Gon-kaduru, *S.* (T.)
Colocasia Antiquorum, which see.
Cyperus Papyrus. Papyrus-grass. (S.)
Eucalyptus robusta. Swamp Mahogany.
Mauritius- or Water-grass, which see.
Heritiera littoralis. Etuna, *S.* (T.)
Herminiera elaphroxylon. Nile Pith.
Lagerstroemia Flos-reginae. Muruta.
Metroxylon Sagu. Sago Palm. (S. or T.)
Nipa fruticans. Water Coconut. (S.)
Ochrosia borbonica. Mudu-kaduru. (T.)
Saccharum arundinaceum. Rambuk, *S*; Elephant-grass. (S.)
S. officinarum. Sugar-cane.
Scaevola Koenigii. Takkada, *S.* (S.)

(B) FOR UP-COUNTRY:

Acacia dealbata. Silver-wattle. (T.)
Eschynomene indica. Shola or Indian Pith Tree.
Eucalyptus globulus. Blue-gum. (T.)
E. leucoxylon. Iron-bark. (T.)
E. robusta. Iron-bark; Swamp Mahogany; and other spp. of Eucalyptus trees.
Fatsia papyrifera. Rice-paper Plant.
Fodder grasses. Mauritius- or Water-grass; Guinea-grass, etc.
Gunnera manicata (*q.v.*).
Hedychium coronarium. Elamal. (S.)
H. gardnerianum. Stems of both spp. recommended for paper pulp.
Phormium tenax. New Zealand Hemp.
Salix babylonica. Weeping Willow. (T.) And other spp. of Willow.
Terminalia glabra. Kumbuk, *S.* Very large tree; good timber. Often found on banks of rivers, etc.

(T.) = Tree; (S.) = Shrub.

CHAPTER XVII

FOR ARID OR SUB-DESERT REGIONS

In regions where arid or semi-desert conditions prevail, or where the annual rainfall is less than 8 in., as is more especially the case in parts of the sub-tropics, cultivation very often can only be carried on under considerable difficulties and by special methods adapted to such localities. Such cultivation as is possible is often confined to the short cold weather season. In some instances, prevailing climatic conditions and the scarcity of water make cultivation impossible at any season. In less unpromising circumstances, however, as in S. Persia, Mesopotamia, etc., it is surprising what can be achieved by perseverance, literally making two blades grow where one or none grew before.

Yet, according to tradition, in these regions once stood the Garden of Eden, with its tempting fruits, and the not-far-distant Hanging Gardens of Babylon, not to mention the land of "flowing milk and honey," whilst the Persian Gardens of the poets are still a fond theme. There is thus some hope here for the keen gardener, and though the results may often be disappointing, success when achieved is doubly gratifying.

The chief difficulties, with suggestions for surmounting them, may be thus summarised :

Absence of Shade, owing to the paucity or non-existence of arboreal growths, is one of the most striking features of desert regions. Therefore one of the first objects in view should be to establish such shade-giving trees or plants as are indigenous or adapted to arid regions. Any vegetation of fairly rapid growth and capable of giving shade is not to be despised, even if it has no claim to natural beauty or other merit.

Scarcity of Water, always a limiting factor in the growth of plants. As the rainfall is extremely scanty, often infinitesimal, means of irrigation, or watering by flooding, must be devised at the outset, without which no cultivation can be accomplished. This usually takes the form of a network of surface drains and channels, connected by larger channels with the nearest river, creek or other source of supply, the water being usually conducted by gravitation. This must be used generously but not extravagantly, especially where the source of supply is limited. The gradient should be only sufficient to cause a gentle flow, which, if too rapid in its course, does not properly saturate the ground, or if too slow will cause waste by evaporation and seepage.

Ridging the soil is generally resorted to, especially where the ground is of a saline nature. The earth is thus raised in broad drills, 2–3 ft. apart according to the nature of the crop, and preferably running east and west. Along the slope of each ridge, near the base, the crop is sown or planted, the roots thus receiving the benefit of the flooded soil, while the

foliage is above the water-level. The interspaces are so connected that the water, when turned on, will move slowly from one to another until the whole is thoroughly soaked. This usually takes a few hours, and may have to be repeated every third day or once a week, according to weather and state of the crop. The regulating of the water from one plot to another is simply effected by the opening or closing of the supply channels, as by placing or removing a few clods of earth.

Saline Character of Soil. In many places this is the most serious obstacle to cultivation, being in some cases insurmountable, as in parts of Iraq, S. Persia, etc., where the salt often appears as a deposit on the surface. (See under *Salt*.) Where, however, the soil is not too strongly impregnated with salt, much may be done to counteract it by repeated ridging and flooding, providing deep drains at intervals for carrying away the saline matter. Some salt-free soil, or manure if obtainable, may with great advantage be mixed with the top soil. The growing of green-manure crops, as barley, berseem (*q.v.*), sesbania, etc., and digging these in an immature state, have the effect of neutralising the salt and at the same time adding valuable humus to the soil.

Persian Garden.
Showing sunken beds, indispensable for the purpose of frequent irrigation.

Scarcity of Manure is often not the least of the natural drawbacks, and this is aggravated by the fact that the natural soil is practically devoid of humus. Such cattle manure as is obtainable is usually in demand for domestic fuel; hence the greater need for green-manuring and adding to the soil any organic matter available. (See *Manures*.)

Strong Parching Winds (Shimal), which often occur in the hottest part of the year, do a great deal of damage to any form of vegetation that may exist in their path. Artificial shelter, such as mud walls, fences of galvanised sheets, or banks of Castor trees (*Ricinus*), or Sanatta (*Dodonea*), etc., should be provided. Young crops may be protected by raising on the windward side of each row a bank of earth supported by scrub or twigs fixed in the ground.

Dust- or Sand-storms, often lasting three or four days at a time, are one of the obstacles to cultivation, sometimes smothering the plants with dust or sand, and injuring or disfiguring the foliage.

Extreme Dry Heat for several months of the year, with a temperature sometimes as high as 130° F., and little or no rainfall, has a desiccating effect and renders frequent irrigation necessary. Certain species, including a few trees and certain bulbs, have become more or less inured to such conditions, and thrive naturally in specially favoured spots, e.g. *Zizyphus Spina-Christi*, Date Palm, bulbous plants, etc. Such plants have acquired the habit of sending their roots deep into the ground, thus rendering them to a large extent independent of rain.

Intensely Cold Winds and even frost in the brief period of winter, render impossible the acclimatisation of many desirable species of tropical trees, etc., which might otherwise be introduced and established. Certain species may, however, become established if assisted to tide over the cold spell during the first year or two, as by artificial protection in the form of grass mats, sacking, or hessian covering.

Planting and Sowing. Generally speaking, a beginning may be made in the sowing of vegetable and flower seeds from the time the hot season begins to cool off, say in October. The ground should first be prepared, the ridges, water channels, etc., being attended to as already stated. Tender or tropical plants are usually best planted out towards the end of the cold season, so as to become established before the hot season is well advanced.

The following selections, which are necessarily limited, are given rather as an indication of what species are worth a trial under such conditions. Some of these have already become acclimatised in S. Persia.

TREES

(*P.* = Persian; *Ar.* = Arabic. For fuller particulars see pp. 79–101, etc.)

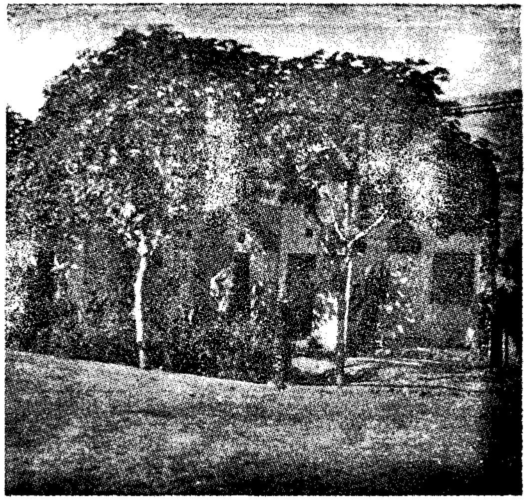
Acacia Farnesiana. Saat, *Ar.* Medium-sized, thorny tree of Egypt, with fine feathery foliage.
Albizzia Lebbek. Sirrus (India). Evergreen with pinnate lvs. Thrives at Mohammerah and Abbadan.
Butea frondosa. Flame-of-the-forest; Pulas, *Hind.* Small or medium-sized deciduous tree (*q.v.*).
Casuarina equisetifolia. She-oak, etc. Similar to *Tamarix*. See p. 94. Adapted to dry sandy region.
Dalbergia Sissoo. Shishum, *Hind.* Upright, deciduous; fine pinnate lvs. Thrives at Basra, Mohammerah, etc.
Dodonea viscosa. Sanatta (India); Pichon (W. Indies). *Sapindaceae.* Small bushy tree or large sh., evergreen, small lvs. Young shoots viscous. Fls. greenish-yellow. Stands drought well. Makes a good hedge from seed. Established at Abbadan, Mohammerah, Basra, etc.
Eucalyptus citriodora. Kaffoor or Kaluptus, *Ar.* Evergreen, spreading habit. Stands drought and salt well. Established at Basra. E. rostrata. Large, evergreen; thrives at Mohammerah, Basra, etc.
Ficus Benjamina. Banyan family. Adapted to dry region. Used as an avenue and street tree in Egypt.
Jacaranda mimosaefolia. Beautiful flowering tree. Thrives in dry regions, as in Egypt, flowering profusely. See p. 85.
Locust-bean. *Ceratonia.* Karnoob, *Ar.* Thrives in Palestine, N. Syria, etc.
Melia Azedarach. Azad-daracht, *P.*; Sabah-bah, *Ar.*; Persian Lilac. Deciduous tree, 30–40 ft. high, with bipinnate lvs. and purplish fls., in panicles.
Morus indica. Mulberry; Toot, *P.*; Tukhi, *Ar.* Thrives in Syria, S. Persia, etc.
Parkinsonia aculeata. Khar, *P.* Small, quick-growing, upright tree of Mexico, with small lvs. and prickly branches; deciduous. Thrives in S. Persia.
Persian Lilac. See above. Thrives from Egypt to S. Persia.

Phoenix dactylifera. Date-palm; Derakhte-khurma, *P.*; Nakhleh, *Ar.* Specially adapted to sub-tropical dry regions, flourishing in brackish soil. See *Fruits*, also p. 244.
Plumeria rubra. Suited to dry localities, but susceptible to frost.
Poinciana regia. Flamboyante; Guli-mohur (India). A quick-growing, spreading, beautiful tree. Adapted to fairly dry localities, but will not stand frost.
Populus alba. White Poplar. Kabudah, *P.*; Kawagh, *Ar.*, and **P. euphratica**; Euphrates Poplar. Both thrive in Iraq and S. Persia.
Prosopis juliflora. Algaroba-bean. Adapted to a dry region. See p. 263.
Salix babylonica. Weeping Willow; Beed, *P.*; Sof-saf, *Ar.* Spreading, deciduous, small tree or large sh., with drooping, slender branches and narrow lvs. Readily prop. by cuttings. **S. persica.** Thrives in S. Persia, Iraq, etc.; spreading freely by suckers.
Salvadora persica. Mustard Tree of Scripture; Tooth-brush Tree. *Salvadoraceae.* Small evergreen tree with small, oval, fleshy, pinnate lvs. of a pungent taste. Often cultivated in N. India, Persia, etc.
Tamarindus indicus. Tamarind; Derakhte-tamar, *P.* Upright spreading tree, with fine feathery foliage. Valuable timber. Thrives at Basra and in Egypt, etc.
Tamarix, several spp. and vars. *Tamaricaceae.* Leafless trees or shs., like **Casuarina,** found in dry regions or near sea-coast. **T. articulata** forms a tree and yields durable timber; thrives in desert regions. See below.
Zizyphus Spina-Christi. Crown-of-thorns. Khunaar, *P.*; Nebbuk, *Ar.* Slow-growing, deep-rooted, evergreen, spreading habit; one of the few trees indigenous to S. Persia, Iraq, etc. Makes a good hedge.

Tamarisk Trees (*Tamarix articulata*) in South Persia.
One of the few trees adapted to desert conditions.

SHRUBS

Buddleia paniculata. Tall sh. with small blue fls.; lvs. covered with greyish-white tomentum.
Castor. See *Ricinus*.
Clerodendron (Caryopteris) odoratum. Free-flowering, white and purple blossom.
Euphorbia pulcherrima. Poinsettia. Bint-et-qonsul. Quick-growing, milky sh., with large, pink bracts.
Hibiscus syriacus. Fls. mauve, bluish-purple, white, etc. Thrives in Palestine, Syria, N. Iraq, etc.
Lawsonia alba. Henna or Hinna. Close growing, slender branches. Suitable for hedges. Powdered lvs. commonly used for dyeing the nails, skin and beard of Mohammedans. See *Dyes*.
Nerium Oleander. Oleander. Khaza-leh, *P.*; Difley, *Ar.* Beautiful free-flowering sh., 6–15, bearing large clusters of pink blossom. Deep-rooted. Stands drought and saline soil. Thrives in Egypt, Baghdad, S. Persia, etc. Prop. by seed or cuttings. See p. 110, also *Poisonous Plants*.
Punica granatum. Pomegranate. An-ar, *P.*; Rum-an, *Ar.* Bears large, bright red fls. Suited to arid conditions.
Ricinus communis. Castor-oil Plant. Beed-anjeer, *P.*; Khurwah, *Ar.* Quick-growing, evergreen, large sh. or small tree. Ornamental only in young state, but is drought- and salt-resistant to a large extent. Commonly used for wind-breaks. Bears seed profusely, for which there is a demand. See *Oils*.

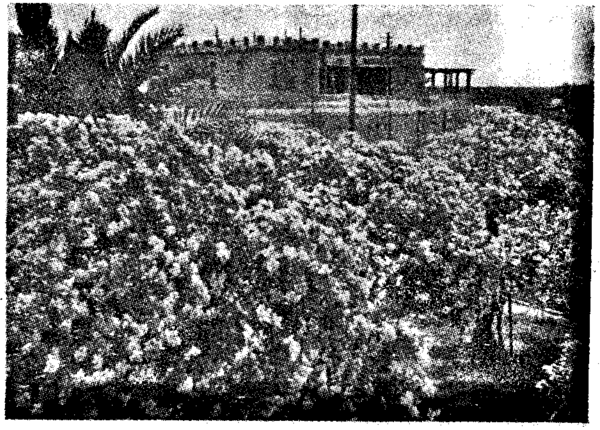


Castor Tree (*Ricinus communis*) in S. Persia.
Appreciated for its shade and adaptability to saline soil.

Russellia juncea. Bush 3–4 ft. with long linear lvs. and scarlet fls.
Schinus molle. Pepper-tree. A large spreading sh., suited to arid conditions. Thrives in Egypt, Baghdad, S. Africa, etc.
Sesbania aegyptiaca. Sesbain, *Ar.*; Aqaqieh, *P.* Quick-growing, upright sh., 8–15 ft., with pale yellow fls. Seeds profusely. Does not stand frost. An excellent green-manure plant when 2 ft. high.
Tamarix mannifera. Tamarisk; Manna; Gaz, *P.*; Tarfa, *Ar.* Slender, leafless, twiggy branches, with pinkish or cream fls.; specially suited to arid, sandy localities. Several vars. found throughout Asia Minor. Prop. by cuttings. The white powdery substance produced from the lvs. by the puncturing of an insect is the manna of the Bedouins. See *Manna*.
Tecoma stans and other spp. Tall shs. or small trees; deciduous. See p. 111.
Thevetia nereifolia. Zard-ganira; Yellow Oleander. Sh. or small tree. Specially suited to dry regions. See p. 113.

PLANTS SUITED FOR HEDGES

Bougainvillea. Beautiful, flowering, climbing sh.; purple and pink vars. Makes a good formidable hedge.
Dodonea viscosa. See under *Trees*.
Lawsonia alba. Henna. See *Shrubs*.
Nerium Oleander. Oleander. Makes a bank of ornamental flowering shrubs rather than a hedge.



Oleander (*Nerium Oleander*) in a Garden at Abbadan, S. Persia.
Showing exceptional luxuriance of growth and richness of blossom.

Pithecolobium dulce. Madras-thorn. A tree, but makes a good hedge from seed.
Zizyphus Spina-Christi. See *Trees*. Makes excellent barrier hedge from seed.

CLIMBERS SUITABLE FOR SCREES, ETC.

Antigonon leptopus. Beautiful pink-flowered climber.
Bignonia venusta. Brilliant orange-yellow.
Bougainvillea. See fig. on p. 198.
Ipomoea palmata. Convolvulus. Commonly known as Railway Creeper in India. Small, finely cut lvs., fls. creamy-white. Deciduous in cold season. Several vars.
Jasminum azoricum. Yasmin; white. **J. Sambac.** Chameli; white.

FRUITS (MEEVAH-JAT, *P.*; MAIWAH, *Ar.*)

(See *Fruits for Low- and Up-Country.*)

Apricot. Zard-alu, *P.*; Mishmish, *Ar.* Native of Asia Minor, Levant, etc., where it is commonly cultivated.
Cape-gooseberry. *Physalis.* Creeping annual, suited to dry climate. Thrives in S. Persia and Iraq. See p. 273.
Dates. Khurma, *P.*; Thamar, *Ar.* The most important fruit-tree of Egypt, Arabia, Mesopotamia, S. Persia, etc. See *Trees*, also pp. 244 and 245.
Figs. Anjeer, *P.*; Teen, *Ar.* Cultivated in Levant, Asia Minor, etc. Suited to dry region.
Grapes. Angoor, *P.*; Anab, *Ar.* Thrives in all warm and dry climates, with cool winter and irrigation. See p. 276.
Locust-tree or **Carob-bean.** *Ceratonia.* Karnoob, *Ar.* Commonly cultivated in Palestine, Levant, etc. Requires a warm, dry climate with a cool winter.
Melon. Khar-beezah, *P.*; Batikh, *Ar.* Annual, thrives in dry climate with irrigation.
Olive. Zaitoon, *P.* and *Ar.* Small tree, commonly grown in Palestine, Levant and other dry regions. See p. 272.
Orange. Madani, *P.*; Narangi, *Ar.* Specially suited to a dry, warm climate with cool winter. Palestine produces and exports the excellent Jaffa oranges. Choice oranges are also grown in Syria, Iraq, Egypt, S. Africa, etc.
Peach. Shaft-alu, *P.*; Khokha, *Ar.* Indigenous to Asia Minor.
Pistachio-nut. *Pistacia.* Pistah-fanduk, *P.*; Frestag, *Ar.* Small tree, commonly cultivated in Syria, Iraq, Persia, etc. Fruit sold in bazaars and coffee-houses.
Pomegranate. *Punica.* An-ar, *P.*; Rumaan, *Ar.* Cultivated throughout sub-tropics, both for fruit and ornament.
Quince. *Cydonia.* Beh, *P.*; Seferjel, *Ar.* Cultivated in parts of Persia, Syria, Levant, etc. Fruit usually eaten cooked, or made into jam, etc.; sold in bazaars when in season. See p. 270.

FOOD-CROPS (SABZI-AL-AT, MAHASEEL-THAAM)

(For further information see pp. 278–316)

Many of the principal vegetables or food-crops of cool countries can be grown in the cold season with much success in many parts of the sub-tropics where irrigation is possible and deep alluvial soil, reasonably free from salt, is obtainable. As the hot season begins to cool off, a beginning should be made in the preparation of the ground for these. Small patches should be sown at intervals of 2–3 weeks, according to crop, in order to keep up a succession. Plentiful manuring is indispensable, cattle manure being preferable. The following are among the principal kinds recommended.

Artichoke, root. Seeb-zameeni, *P.* (= "Potato"); Tartoufa, *Ar.*
Barley. Jow, *P.*; Shae-eer, *Ar.* Commonly grown as a cold weather crop in Iraq, S. Persia, N. India, etc.
Beans, dwarf-. Loobeya, *P.*; Fassulya, *Ar.* **Beans, broad-.** Bagha-lah, *P.*; Bajilla, *Ar.* The latter appear to be naturalised about Baghdad.
Beetroot. Cho-gondar, *P.*; Swandar, *Ar.*
Brinjal (Egg-plant). Badinjan. *P.* and *Ar.*

Cabbage. Kalam, *P.*; Lahana, *Ar.* (Original cabbage indigenous in S. Persia, etc.)
Carrots. Zar-dak, *P.*; Jazar, *Ar.*
Cauliflower. Kalami-rumi, *P.*; Karnabeet, *Ar.* Large heads may be obtained in cold season; one of the most successfully grown vegetables in S. Persia and Iraq.
Celery. Kalafs, *P.*; Krafus, *Ar.* **Chillies.** Fil-fil, *P.* and *Ar.*
Cucumber. Kheyal, *P.* and *Ar.*
Fennel. Shoo-wit or Shev-ed, *P.*; She-bint, *Ar.* Used for flavouring.
Garlic. Seer, *P.*; Thoom, *Ar.* Much in favour, as in all hot countries.
Green-gram. Mash, *Ar.* Commonly grown in Iraq, etc., in cold season.
Ground-nuts. Funduk-zami-ni, *P.*; Fustuk-el-abeed, *Ar.*
Lentils. Aades or Ah-des, *P.* and *Ar.* **Lettuce.** Kahu, *P.*; Khus or Khos, *Ar.*
Maize (*Zea*). Cultivated as a garden- or field-crop from Egypt to Iraq, etc.
Mint. Poodi-na, *P.*; Na-nah, *Ar.*
Okra. Lady's Finger. Barmi-ah, *P.* and *Ar.*
Onions. Peyaz, *P.*; Basal, *Ar.* **Parsnip.** Havij, *P.*; Jaz-ar, *Ar.*
Peas. Mokhud-faranji, *P.*; Hum-mus, *Ar.*
Potatoes. Seeb-Zameeni, *P.*; Batata, *Ar.*
Tomato. Patish-gah, *P.*; Tamata, *Ar.*

FLOWERS (Gul, *P.*; Waridd or Azahar, *Ar.*)

Antirrhinum. Guli-meymoon, *P.*; Halg-es-sabi, *Ar.*
Aster (Annual). Guli-meenas, *P.*
Callendula persica. Persian Marigold. Hamish-behar, *P.*
Candytuft, white. Moravari-safid, *P.*
Chrysanthemum, different vars. Da-oodi, *P.* and *Ar.*
Coreopsis. She-ashrafi, *P.* **Cornflower.** Guli-takh, *P.*; Shabsi-masri, *Ar.*
Dianthus. Galamfor, *P.*; Kurnfil-chini, *Ar.*
Eschscholtzia. Khush-khash, *Ar.*
Gaillardia. Ra-nah-zeeba, *P.*; Amr, *Ar.*
Gladiolus. Khwasa, *P.* and *Ar.* Indigenous in S. Persia.
Grape Hyacinth. *Muscari.* Cheer-khala, *P.*; Ansalan, *Ar.* Common in Mespot.
Hollyhock. Khatmi, *P.* and *Ar.* Numerous very showy vars., mostly single fld. Nat. or indigenous in Iraq and S. Persia.
Larkspur. Guli-apaska-far, *P.*; Obertarkh, *Ar.*
Linum (Linseed). Roghan-bazrak, *P.*; Zahas-bizri, *Ar.*
Narcissus. Nar-ges, *P.*; Narkiz, *Ar.* Indigenous in S. Persia.
Petunia. Atlessi, *P.* Single vars.
Poppy. Guli-toriak, *P.*; Khosh-khash, *Ar.* Opium Poppy, cultivated in Persia.
Rose (Persian). Guli-seurkh, *P.*; Juri-waridh, *Ar.*
Verbena. Sha-passan, *P.* and *Ar.* (= Shah's favourite).
And many others during the cold season. See pp. 127–133, etc.

CHAPTER XVIII

SHADE-, WIND-BELT-, TIMBER-, FUEL-TREES, ETC.

(1) *FOR AVENUES & ROADSIDES.*
(2) *FOR PARKS & OPEN SPACES.*
(3) *SHADE FOR FIELD CROPS.*
(4) *WIND-BREAK TREES.*
(5) *FOR FUEL, TIMBER, ETC.:—*
(A) FOR LOW-COUNTRY; (B) FOR UP-COUNTRY.
(6) *PACKING-CHEST WOODS.*
(7) *TIMBERS AND CABINET WOODS OF THE TROPICS.*
(8) *WOODS REASONABLY IMMUNE FROM TERMITES.*

THE importance of shade trees in the tropics is impossible to over-estimate; they are in many cases essential to the successful cultivation of crops, and a boon to man and beast on account of the shelter they afford from the fierce sun, as well as for their effect in tempering the atmosphere and conserving moisture in the soil. Most crops in the tropics are benefited by moderate shade, especially in the earlier stages of growth; while in exposed situations protection from strong winds, as may be afforded by suitable trees, is equally important. Shade trees in moderation enhance the beauty of one's surroundings, and render the atmosphere cooler and healthier. In malarial districts, the hygienic effect of certain species in draining marshy land is well known. Trees must not, however, be planted so closely as to interfere with the free circulation of air around dwellings or to cause excessive damp shade, which encourages mosquitoes. Brittle or soft-wooded trees, as Spathodea, if planted near buildings may be a source of danger from their liability to be blown over by gales, while others, as certain species of Ficus, are objectionable on account of their extensive or shallow root-system. Others again, *e.g.* Casuarina, frequently block gutterings, drains, etc., by the almost constant dropping of their leaves.

Qualities of Shade Trees. The suitability of shade trees depends much on local conditions and individual requirements. In some localities they may be selected with a view to furnishing crops of marketable fruit or other useful product in addition to shade. Thus in parts of India, shade trees sometimes serve as Lac-producers, *e.g.* Mangoes, Tamarind, etc.; while in some European countries the leasing of fruit-trees planted for shade along public roads is a national source of revenue.

The following are essential qualities of a good roadside shade tree: (1) It should be evergreen, or at least have the habit of putting on fresh foliage immediately after shedding the old leaves; (2) it should have an upright spreading form, with semi-erect rather than drooping branches; (3) a deep-rooting system so as to afford good anchorage; (4) straight upright stem for at least 8 ft. from the ground; and (5) light feathery foliage, preferably such as close up at night (*e.g.* Rain Tree). Large leaves are to be avoided, as they may cause cars to skid or horses to shy, and are liable to do damage to roads by drip. The tree chosen should be a moderately rapid grower; too rapid growth, however, generally means short-lived trees. Species with large heavy fruits, *e.g.* Jak Tree, have obvious drawbacks. The merit of any

shade tree depends largely on the attention given it in the young state, as well as on the manner of planting. Careless planting, injury by cattle, etc., when young, or ruthless treatment by disinterested owners of adjoining land, will permanently impair or disfigure any trees.

It is therefore desirable that certain recognised rules, such as the following, be adopted for trees planted along roadsides or in other public places:

(*a*) Proper holes to be prepared before planting, each to be about 3 ft. deep by 4 ft. in diameter, and, beginning with a layer of drainage material, filled in with good soil and some well-rotted manure.
(*b*) Where possible, holes to be well behind the side-drains, not between them and the road, thus allowing for the trees when full-grown almost to meet near the centre of the road.
(*c*) Plants to be well established in bamboo pots or baskets before being planted out.
(*d*) Planting to be started as far as possible at the commencement, not towards the end, of the rainy season.
(*e*) Distances for planting to be about 30–35 ft. according to species and circumstances, or about 50 ft. for very large kinds. Half these distances may, however, be adopted in the first place, allowing for every alternate tree to be cut out when they begin to touch each other. Or, as an alternative, a quick-growing species may be interplanted with the slower-growing permanent trees, and cut out when it begins to encroach on the latter.
(*f*) Proper protection to be provided, either collectively or individually, against cattle, etc., by means of fences or tree-guards until at least the trees are sufficiently established to take care of themselves.
(*g*) Wilful damage to, or interference with, the growth and proper development of the trees to be prohibited by law.

TREES FOR AVENUES, ROADSIDES, ETC.

The following have qualities to recommend them as shade for roadsides, depending however on locality:

Azadirachta indica. Margosa; Kohomba, *S*; Vempu, *T*; Thini (India). *Meliaceae.* Small or medium-sized, evergreen tree with straight stem and small, pinnate lvs. Stands drought well; much planted in avenues in India. See *Med. Plants.*

Caesalpinia coriaria. Divi-divi. A small or medium-sized, slow-growing, evergreen tree, with very small bipinnate lvs. and small, sweet-scented, greenish-white fls. See *Orn. Fol. Trees*; also *Tans.*

Carallia integerrima. Dawata, *S. Rhizophoraceae.* A small or medium-sized, slow-growing, symmetrical tree with a spreading head and rather small, dark-green lvs. Specially suited to the sea-coast; entirely evergreen.

Doona ovalifolia. Yakahalu or Pini-beraliya, *S. Dipterocarpaceae.* Large handsome tree, with semi-drooping branches and small, ovate, pointed lvs. Ceylon, moist low-country, endemic.

Fagraea fragrans. Tembusu. *Loganiaceae.* Ornamental, upright, evergreen, small-leaved tree of Malaya, often planted for ornament in that country. Though of rather slow growth, this has excellent qualities for an avenue tree, retaining its upright, well-balanced habit. Introduced to Ceylon in 1891.

Filicium decipiens. Pihimbiya, *S*; Fern-leaf Tree. See *Orn. Fol. Trees.*

Lafoensia vandelliana. *Lythraceae.* A small or medium-sized, erect, evergreen tree with small lvs. Native of Brazil, introduced to Ceylon in 1856.

Lagerstroemia Flos-reginae. Queen Flower; Muruta, *S.* A medium-sized tree with spreading branches. Sheds the lvs. for a short period in the dry season. See *Flowering Trees.*

Mesua ferrea. Ceylon Iron-wood; Na-gaha, *S.* A medium-sized, slow-growing, evergreen tree with small, dense foliage. See *Flowering Trees*, etc.

Peltophorum ferrugineum. Iya-vakai, *T.* A handsome tree for wide thoroughfares. See *Flowering Trees.*

Pithecolobium Saman. Rain Tree; Saman. An excellent tree for roadsides up to a certain age, but in hot, moist regions, at low elevations, assumes a great size, with large spreading surface roots, often becoming top-heavy after the age of 40–50 years. See *Orn. Fol. Trees*, etc. **P. dulce.** Madras Thorn. A small or medium-sized tree, with small lvs. in 2 pairs; young shoots prickly. Thrives either in deep soil or dry sandy locality; naturalised about Colombo. Commonly planted for hedges.

Poinciana regia. Flamboyante. (See *Flowering Trees.*) A beautiful tree for avenues or roadsides, but is liable with age to develop buttressed roots, making it unsuitable for narrow thoroughfares.

Polyalthia longifolia. Mara-illupai, *T. Anonaceae.* A moderate-sized, evergreen, symmetrical, upright tree with narrow, wavy lvs., much planted for avenues in India; drought-resistant and suited to indifferent soil. Seeds in Sept.–Oct.

Pongamia glabra. Indian Beech; Punku, *T*; Magul-karanda, *S. Leguminosae.* A handsome tree with glossy pinnate lvs., bearing racemes of creamy-white, scented fls. Esteemed in India as a street tree. Good timber; foliage relished by cattle in time of drought.

RAIN TREE OR SAMAN (*Pithecolobium Saman*). As a roadside shade tree.

Swietenia Mahagoni. Mahogany. A favourite tree for roadsides in the north of Ceylon and parts of India. See *Orn. Fol. Trees.*

Tamarindus indicus. Tamarind; Siyambala, *S*; Pulli, *T. Leguminosae.* A moderate-sized or large, handsome, evergreen, slow-growing tree, with straight, erect stem and small pinnate lvs.; thrives in moist as well as dry districts up to 2,000 ft. elevation. In the north of Ceylon and in parts of India it is commonly planted for roadsides. Being a long-lived tree, it is well adapted for avenues. It is noted for its hard and beautifully marked dark-red timber. Several vars. are recognised in India. See *Med. Plants.*

TREES FOR PARKS, OPEN SPACES, ETC.

(See *Flowering and Ornamental Foliage Trees.*)

For scenic effect it is difficult to surpass the beauty of isolated specimen trees of well-balanced proportions, with drooping or spreading branches, set at wide distances or in groups in an expanse of pasture or park land. In addition to their landscapic effect, they encourage by their cool shade the growth of green grass or pasture, especially if sufficient clearance is maintained between the ground and the lower branches, whilst they may also afford a welcome shelter and shade for grazing animals.

Beautiful flowering- as well as fine foliage-trees should be represented in a selection for this purpose, including such as the Rain Tree (*Pithecolobium*), Padouk (*Pterocarpus*), Mahogany (*Swietenia*), Tamarind (*Tamarindus*), Flamboyante (*Poinciana*), *Amherstia, Peltophorum, Lagerstroemia,* etc. For a description of these see *Flowering Trees, Fol. Trees,* etc.

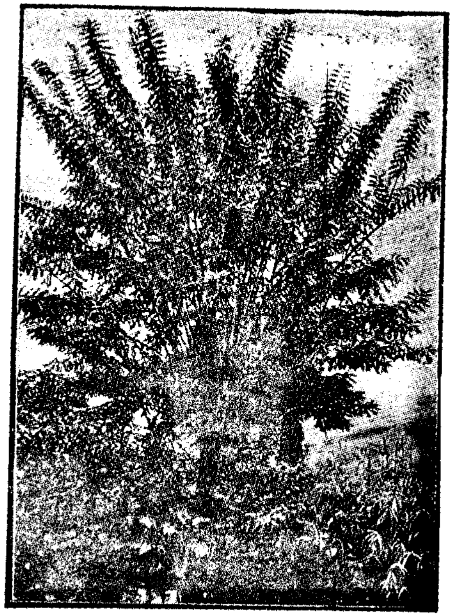
SHADE TREES FOR FIELD CROPS

(See also *Green Manures.*)

Suitable shade trees, thinly planted and properly attended to, have beneficial effects, physically and chemically, on most crops, especially at low or intermediate elevations, in the tropics. They help to conserve moisture in the soil, and aerate the latter by means of their deep-feeding roots, which bring plant-food from the under strata to be returned again in the form of mulch by the fallen leaves. At the higher altitudes, however, shade becomes less necessary to crops, but wind-belts more essential. Leguminous trees are generally preferable for this purpose for the following reasons:

(1) They are usually fast growers; (2) their thin feathery foliage does not form too dense a shade; (3) their lvs. have often the habit of closing up at night; and (4) they are generally rich in nitrogen and have the property of collecting free nitrogen by means of bacteria nodules on their rootlets. The branches may be lopped periodically during the wet seasons or when less shade is required, and the young foliage and twigs buried among the crop to supply green manure.

The following is a selection suitable for shade purposes, all being leguminous, except where otherwise mentioned. See under *Coffee.*



MADERA (*Gliricidia maculata*). Quick-growing shade tree.

Albizzia moluccana. Sau Tree; Rata-mara, *S*; Sahki-marram, *T.* A large, very quick-growing tree, with thin feathery foliage; fls. in Dec.–Jan. Wood soft, suitable for tea-boxes, etc. **A. stipulata.** Kabal-mara, *S.* Similar to the above, but distinguished by the reddish stipules. **A. Lebbek.** Lebbek; Siris (India). Commonly grown for shade in India, Java, W. Indies, etc. Light feathery foliage. See *Fuel and Timber Trees.*

Dalbergia (Deguelia) microphylla. A small tree with fine foliage, used as a shade tree for Coffee in Java.

Erythrina lithosperma. Dadap; Murunga-mara, *T.* A moderate-sized spineless tree of very rapid growth, with trifoliate lvs.; affords a large quantity of green material valued for mulching or green-manuring. 1 ton loppings has been found to contain 61·50 lb. nitrogen, 57·38 lb. potash, 15 lb. lime, and 13·68 lb. phosphoric acid; readily prop. by stem- or branch-cuttings planted *in situ*, or from seed. Thrives up to 4,000 ft. Occurs in scarlet and orange-fld. vars.; rather showy when in flower, in dry season. See *Green Manures.* **E. umbrosa**; Anauca or Mortel of the W. Indies. A moderate-sized tree with large, trifoliate lvs., used as shade for Cacao and other crops in the W. Indies. Readily prop. by large cuttings or from seed. **E. velutina**; Bocare. A popular shade tree in the W. Indies; has soft, tomentose lvs. and salmon-yellow fls. Madre-de-Cacao is a general term for species of Erythrina in S. America.

Gliricidia maculata. Madera. A quick-growing small tree, with long leafy branches; excellent shade for general crops. Readily prop. from branch-cuttings planted *in situ*, or from seed. Young trees may be topped at a height of about 6 or 8 ft., so as to form a spreading head. Loppings form an excellent mulch or green-manure for crops or borders; commonly used in Trop. Amer., etc., as shade for Cacao. Planted 20 × 20 ft. (109 to the acre), it may later be thinned out to 40 × 40 ft. See *Orn. Fol. Trees.*

Grevillea robusta. Silky Oak. *Proteaceae.* An upright, medium-sized tree of Australia, with light feathery foliage, silvery-white underneath, much planted for shade amongst Tea, also for wind-belts, fuel reserve, etc., in Ceylon, India and elsewhere. Prop. by seed. See *Up-country Fol. Trees.*
Inga laurina. Pois-doux; Spanish Ash. A medium-sized tree, used in the W. Indies as a shade tree for Cacao, etc.
Myroxylon Toluifera. Balsam-of-Tolu. Suitable as a permanent shade tree for field crops. See *Wind-break and Fuel Trees.*
Pongamia glabra. Punku, *T*; Magul-karanda, *S.* See p. 210, etc.
Tecoma leucoxylon. White Cedar. *Bignoniaceae.* An upright tree, commonly used in parts of W. Indies as a wind-break and shade tree for Limes, etc.

WIND-BREAK TREES

Chiefly for Up-Country

A wind-break may be defined as a belt of trees which gives protection to growing crops from prevalent, strong winds. In some localities, as on exposed ridges, especially at the higher elevations, such protection is indispensable to most crops. An ideal wind-break may consist of rows of tall trees in the centre, shorter ones closely planted on either side, and outside these bushy trees or shrubs. Suckers and seedlings should be encouraged to grow up to form a dense undergrowth, so that in the event of any of the older trees being used for fuel or timber their place may be naturally supplied by these. The line of such a belt should, as far as possible, be at right angles to the direction of the prevailing winds. Where the roots of wind-break trees are liable to spread to the detriment of the adjacent crops, a deep trench should be dug to prevent their encroachment. Well established wind-belts may become a useful source of timber and fuel for estate use, especially when formed of species adapted to coppicing; or they may be constituted so as to yield a subsidiary crop, as Camphor, Annatto, Croton-oil, Cashew-nut, etc. An ideal wind-break tree should be of a spreading habit, with strong tough wood, dense and evergreen foliage, and have the power of natural regeneration by seedlings or suckers, *e.g.* Silver-wattle and other species of Acacia. The following is a general selection:

Acacia dealbata. Silver-wattle. **A. decurrens.** Black-wattle. **A. melanoxylon.** Black-wood. Suited to elevations of about 4,000–6,000 ft. See *Up-Country Trees.*
Andira inermis. Angelin; Bastard Mahogany. Leguminous tree, used for wind-belts in the W. Indies.
Calophyllum Walkeri. Kina, *S.* *Guttifereae.* Large tree, with stout, straight trunk and a round head; common in Ceylon at the higher elevations.
Cedrela serrulata. Red Toon. Suited to Up-country.
Cinnamomum Camphora. Camphor (*q.v.*).
Cupressus knightiana; **C. macrocarpa.** See *Up-country Trees.*
Eucalyptus marginata. Jarrah. W. Australia. (See *Timber Trees.*) **E. diversicolor** (Karri Gum; a handsome tree). **E. obliqua** (Stringy Bark). **E. amygdalina** (Peppermint Gum). **E. robusta** (Iron Bark; Swamp Mahogany). An upright, tall tree with rough brown bark and large ovate lvs., much planted for timber and fuel reserves in Ceylon and S. India. See p. 214.
Eugenia Jambos. Jambu. A small, medium-sized, dense, evergreen tree. See *Trop. Fruits.*
Grevillea robusta. Silky Oak. See *Up-country Trees.*
Inga laurina. Pois-doux; Spanish Ash or Spanish Oak. A leguminous medium-sized tree, used for wind-breaks, etc. in Dominica and other W. Indian Islands.
Mesua ferrea. Ceylon Iron-wood. **Michelia nilagirica.** Wal-sapu, *S.*
Myroxylon Toluifera. Balsam-of-Tolu (*q.v.*). **Tecoma leucoxylon.** White Cedar.

TREES FOR TIMBER, FUEL, ETC.

(A) For Low-Country

The value of any timber for building purposes, furniture-making, etc. depends largely on its being properly seasoned. This may be effected in several ways, as by water, steam, dry heat, smoke, or by natural air circulation. The chief object of seasoning is to expel or dry up the fermentable matter or sap. Imperfectly seasoned timber is liable to decay rapidly, or to attacks by the boring beetle (*Xylothrips flavipes*) and other insects. Seasoning is usually done in Ceylon by water, which is better and more rapid than by air, especially if it is running water, as the sap is thus dissolved out of the wood and replaced by air. It is important that logs should be peeled immediately they are felled and as soon as practicable placed in water. Timber in planks, rafters, etc. should also be submerged and held down by chains and stones. Seasoning in brackish water is believed to render the timber harder and more durable. Drying should be carried out under cover and as rapidly as possible.

Cork- or Balsa-Wood (*Ochroma Lagopus*).

Albizzia moluccana. Albizzia. Vachimaram, *T.* A fast-growing, very large tree, yielding a large quantity of fuel; wood light, suitable for tea-chests.
Artocarpus integrifolia. Jak; Kos, *S.* A large tree, affording excellent timber, yellow when fresh, becoming dark-red like mahogany with age; much used for furniture, etc. in Ceylon. See *Tropical Fruits.*
Canarium bengalense. *Burseraceae.* A tall erect tree, with straight, smooth stem and large pinnate lvs. Wood white, light, used in Bengal for packing chests, also for shingles. Yields a resin used in incense.
Cassia siamea. Wa, *S*; Vakai, *T.* A large, quick-growing tree; heartwood yields hard, dark-red timber; excellent fuel.
Casuarina equisetifolia. She Oak; Beef-wood; Kana- or Kasa-gaha, *S.* Very hard, durable wood, suitable for beams, posts, etc. but not for planks; does not last well under ground. Excellent fuel. See *Fol. Trees*, also *Tans*, etc.
Cedrela odorata (Toon Tree). **C. serrulata** (Red Toon). Both useful timbers.
Eucalyptus robusta (Iron-bark; Swamp Mahogany); **E. marginata** (Jarrah); **E. globulus** (Blue-gum), and numerous other spp.
Filicium decipiens. Pihimbiya, *S.* A rather slow-growing tree; excellent reddish timber, tough and heavy, valued for cart-wheels, etc. See *Orn. Fol. Trees.*
Grevillea robusta. Silky Oak (*q.v.*). Useful shade, timber and fuel.
Melia dubia. Lunu-midella, *S*; Malai-vempu, *T.* A large, handsome, quick-growing spreading tree; wood light, soft, brownish-red; much used for ceilings, also as outriggers for native boats. Seeds in Jan.–March; fruit a hard, horny drupe, containing 2–4 small seeds. See *Orn. Fol. Trees.*
Mesua ferrea. Ceylon Iron-wood; Na-gaha, *S.* Slow-growing, straight-stemmed tree; timber dark-red, very hard and durable. See *Flowering Trees*, etc.
Michelia Champaca. Champac; Sapu, *S.* *Magnoliaceae.* Large quick-growing tree, with long, oval, pointed lvs. and scented, creamy-white fls. Yields service-

able building timber and good fuel. Heartwood dark-purple when freshly cut, turning to brown. See *Perfumes*.

Myroxylon Toluifera. Balsam-of-Tolu. A moderate-sized or large, leguminous, evergreen tree; splendid timber, dark-red and close-grained.

Ochroma Lagopus. Down Tree; Cork- or Balsa-wood. *Bombaceae*. A quick-growing tree of Cent. Amer., with large, angular or lobed, pubescent lvs., 60–70 ft. high. Wood notable for its light pith-like texture, used for floats and rafts; largely in demand during the Great War for life-rafts, mine barrage, insulating purposes, aeroplane construction, etc. When dry, it has a weight of about 7 lb. per cubic foot, while cork weighs 13½ lb. Iron-wood (*Mesua*) and Ebony (*Diospyros*) weigh 70–80 lb. or more per cubic foot. The fine silky down from the fruit is used for stuffing pillows, etc. Introduced at Peradeniya in 1884; grows rapidly and produces seed from March–May.

Pterocarpus marsupium. Gammalu, *S*. A wide-spreading, handsome tree, fine, dark, hard timber.

Thespesia populnea. Tulip-tree; Suriya, *S*. A sea-coast tree (*q.v.*).

Vitex altissima. Milla, *S*; Kadamanakku, *T*. *Verbenaceae*. A large tree with a dense head and drooping branches, common in dry low-country of Ceylon; valuable timber, hard, heavy, close-grained, smooth, tough and durable. Commonly used for cart wheels.

TREES FOR TIMBER, FUEL, ETC.

(B) For Up-Country

Acacia decurrens, var. mollissima. Black- or Tan-wattle. Australia. A large, quick-growing tree, suited to high elevations or sub-tropical conditions, but susceptible to heavy rains and strong winds. **A. melanoxylon.** Black-wood Tree. A fairly large tree, of comparatively slow growth; stands wind well; excellent timber and fuel. **A. pycnantha.** Golden Wattle. 40–50 ft. high. Good timber. See *Up-country Trees*, also *Tan Barks*.

Acrocarpus fraxinifolius. Shingle Tree; Pink Cedar. (See *Up-country Trees*.) Sapwood white, heartwood reddish, moderately hard; used in S. India for furniture, building, etc. and in Darjeeling for tea-boxes.

Albizzia moluccana. Suited to medium elevations. See pp. 211, 213.

Cedrela serrulata. Red Toon; Red Cedar; Java Mahogany (*q.v.*). **C. Toona.** Toon Tree. See *Up-country Fol. Trees*.

Cupressus knightiana and **C. macrocarpa** (*q.v.*).

Eucalyptus leucoxylon. Iron-bark Tree. *Myrtaceae*. Australia. A large tree, yields very hard, durable and strong timber, used by cartwrights, shipbuilders, etc. in Australia. **E. marginata.** Jarrah. W. Australia. Large tree; yields valuable, durable timber, resistant to termites and other insects; largely exported and used for sleepers, street-paving, house- and jetty-building, etc. **E. robusta.** Swamp Mahogany. Tall upright tree with rough brown bark and large ovate lvs., much planted for timber and fuel reserves at elevations of 3,000–6,000 ft. in Ceylon. Numerous other spp.

Grevillea robusta. Silky Oak. See foregoing, also *Up-country Trees*.

Michelia nilagirica. Wal-sapu, *S*. *Magnoliaceae*. A moderate-sized shrubby tree, with a round head, common in moist forests above 4,000 ft.; one of the best of the indigenous mountain timbers of Ceylon.

PACKING-CHEST WOODS

Suitable woods for packing-chests for transporting produce should be light, strong and of even tare. For edible produce it is essential that they should also be devoid of odour. Plywood, which generally combines these qualities, is usually preferred when the cost does not make it prohibitive. Momi-wood (*Abies firma*) is generally imported from Japan in this form for use as tea-chests in Ceylon. The following are a few of the most suitable woods in Ceylon for packing-chests:

Albizzia moluccana. Mara. **A. odoratissima.** Suriya-mara.
Aleurites triloba. Tel-kekuna.
Alstonia scholaris. Ruk-attana.
Bombax malabaricum. Katu-imbul.
Cananga odorata. Wana-sapu.
Campnosperma zeylanicum. Aridda.
Ficus callosa. Wal-gona.
Litsea chinensis. Bombe.
Macaranga tomentosa. Kenda.
Melia dubia. Lunu-midella.
Myristica laurifolia. Malabodda. **M. Iriya.** Iriya.
Sarcocephalus cordatus. Bakmi.
Sterculia foetida. Telambu.
Vateria acuminata. Hal.

IMPORTANT TIMBERS AND CABINET WOODS OF THE TROPICS

Altingia excelsa. Rasamala. *Hamamelidaceae.* One of the largest of tropical trees, native of Java, etc., with clear stem often reaching 100 ft. high and diameter of 8 ft. or more at base. Good timber.

Billion. (Eusideroxylon Swageri. *Lauraceae.*) Iron-wood of Borneo.

Black Wattle. (Acacia decurrens, var. mollissima. *Mimoseae.*) S. Australia.

Blackwood of Australia. (Acacia melanoxylon.) S. Australia.

— of India. Bombay-wood. (Dalbergia latifolia. *Leguminosae.*)

Blue Gum. (Eucalyptus globulus) (*q.v.*). Excellent Australian timber.

Boxwood, Cape. (Chiefly Buxus Macowani. *Euphorbiaceae.*) S. Africa.

—, Ceylon; Gal-karanda. (Canthium didymum. *Rubiaceae.*) Ceylon, India, etc. Wood hard, grey, close-grained.

—, Jamaica. (Casearia praecox. *Samydaceae.*) A small tree.

Brachylaena Hutchinsii. (*Compositae.*) A tall tree of E. Africa. Wood strong, even-grained, resists termites and beetles. Used for sleepers, etc.

Brazilletto-wood. (Peltophorum Linnaei. *Leguminosae.*) W. Indies.

Bullet Tree. (Mimusops globosa. *Sapotaceae.*) Guiana. Very hard and durable; sometimes used as a substitute for Greenheart. Yields gutta (balata).

Calamander. (Diospyros quaesita. *Ebenaceae.*) Ceylon. Fancy cabinet wood, rare.

Camwood. (Baphia nitida. *Leguminosae.*) W. Africa. Wood hard, heavy.

Cedar, Red; Toon Tree. (Cedrela Toona.) Bengal, Burma, etc. Light, reddish, mahogany-like timber; resistant to termites.

—, Jamaica or Honduras. (Cedrela odorata.) Wood similar to preceding sp., but more fragrant.

—, East African. (Juniperus procera. *Coniferae.*) Large tree, 100–130 ft. high, with girth of 15 ft. at base; found at 6,000–9,000 ft. Timber light, reddish-brown, fragrant, durable; resistant to termites.

Chengal or Penak. (Balanocarpus maximus. *Dipterocarpeae.*) Large, upright tree; standard timber of Malaya.

Chittagong Wood; Hulan-hik, *S*; Kaloti, *T*. (Chickrassia tabularis. *Meliaceae.*) Ceylon, India, Burma. Hard, brownish-red, durable wood; valued for carving, furniture-making, etc.

Chloroxylon excelsa. (*Meliaceae.*) Handsome tree of Trop. Africa. Excellent timber. See Satinwood.

Coffin Tree. (Machilus Nanmu. *Lauraceae.*) China. Upright, conical, evergreen tree, much planted at temples in China. Timber noted for durability.

Crabwood; **Carrapa** or **Carapa.** (Carapa guianensis. *Meliaceae.*) Guiana. Large, handsome tree. Excellent timber for building, furniture, etc. Good substitute for mahogany.

Dattock. (Detarium guineense. *Leguminosae.*) Trop. Africa. Large handsome tree; wood exported under name of African Mahogany.

Ebony, Ceylon. (Diospyros Ebenum. *Ebenaceae.*) Ceylon. The hard, black heartwood is exported and usually worth from £20 to £40 or more per ton.

—, Jamaica; **Cocos-wood.** (Brya Ebenus. *Leguminosae.*) W. Indies.

—, Malabar. (Diospyros melanoxylon. *Ebenaceae.*) S. India.

Gammalu, *S*. (Pterocarpus marsupium. *Leguminosae.*) Ceylon and India.

Greenheart. (Nectandra Rodioei. *Lauraceae.*) Brit. Guiana. Very hard and durable, especially under water; largely used for piles, dock-gates, etc.

Hal-milla, *S*. See Trincomalie-wood. Formerly exported from Ceylon.

Ironbark. (Eucalyptus robusta and E. leucoxylon.) New South Wales, etc.

Ironwood, Ceylon. (Mesua ferrea.) See *Orn. Fol. Trees*.

—, Borneo. (Eusideroxylon Swageri. *Lauraceae.*) See **Billion**.

Jakwood. (Artocarpus integrifolia. *Urticaceae.*) India, etc. Standard timber of Ceylon. See p. 213, also *Trop. Fruits.*

Jarrah. (Eucalyptus marginata.) W. Australia. Very hard and durable, much exported; used for paving-blocks, sleepers, building, etc.

Lignum Vitae. (Guaiacum officinale. *Zygophyllaceae.*) Trop. Amer.

Locust Tree. (Hymenaea Courbaril. *Leguminosae.*) Hard, tough, durable. Brit. Guiana. See *Gums and Resins.*

Mahogany. (Swietenia Mahagoni and S. macrophylla.) One of the finest of commercial timbers. The latter species is considered to be the source of Honduras and Mexican mahogany, the former yielding Cuban Mahogany.

—, African. (Khaya senegalensis and other spp. *Meliaceae.*) W. Trop. Africa.

—, Australian. See Jarrah.

—, Bastard. (Andira inermis. *Leguminosae.*) Trop. Amer. and W. Indies.

—, Indian. (Cedrela Toona. *Meliaceae.*) India, Java, etc.

—, Philippine. See Padouk.

—, Swamp. (Eucalyptus robusta.) Australia. Large-leaved, robust tree.

Milla, *S.* (Vitex altissima. *Verbenaceae.*) Ceylon and India.

Mirabow. (Afzelia palembanica. *Leguminosae.*) Borneo and Malaya.

Mora. (Dimorphandra Mora. *Leguminosae.*) Guiana. Very large tree; hard, durable wood; good for sleepers, paving, etc. See *Orn. Fol. Trees.*

Mosquito-wood. (Mosquitoxylum jamaicense. *Leguminosae.*) W. Indies.

Nedun, *S.* (Pericopsis mooniana. *Leguminosae.*) Ceylon. Beautiful cabinet wood, dark, finely marked and grained, now becoming scarce.

Oak, African. (Lophira alata. *Ochnaceae.*) W. Trop. Africa.

—, Ceylon. (Schleichera trijuga. *Sapindaceae.*) Ceylon, India, Java, etc. Foliage resembles that of English Oak. Wood not of special importance.

—, She. (Casuarina equisetifolia. *Casuarineae.*) Queensland, N.S. Wales, etc.

—, Silky. (Grevillea robusta. *Proteaceae.*) Wood white, prettily marked.

Padouk. (Pterocarpus indicus. *Leguminosae.*) Andaman Is. Excellent hard, reddish timber; much exported. See *Orn. Fol. Trees.*

Palisander-wood. (Machaerium firmum. *Leguminosae.*) See **Rosewood.**

Palu, *S.* (Mimusops hexandra. *Sapotaceae.*) Ceylon and India. Wood very hard, heavy and durable, used for sleepers, etc.

Pehimbiya. (Filicium decipiens. *Burseraceae.*) Ceylon and W. India (*q.v.*).

Podocarpus gracilior. Podo. Tall handsome tree of E. Africa attaining over 100 ft. Fine timber, ornamental foliage.

Porcupine-wood; Coconut. (Cocos nucifera. *Palmae.*) See *Coconut.*

Purple-heart. (Copaifera pubiflora. *Leguminosae.*) British Guiana.

Pyinkado. (Xylia dolabrifolium. *Mimoseae.*) Large deciduous tree of Burma, where its timber is considered next in importance to Teak.

Redwood, Andamans. (Pterocarpus dalbergioides.) Handsome tree, fine timber.

—, Indian. (Soymida febrifuga. *Meliaceae.*) Central India, etc. Resistant to termites. Bark considered febrifugal.

Rosewood, Tiger-wood. (Machaerium firmum. *Leguminosae.*) Brazil.

—, Burmese. See *Padouk.* (Pterocarpus indicus. *Leguminosae.*) Burma.

—, Indian, or Bombay-wood. (Dalbergia latifolia. *Leguminosae.*) Bengal, etc. Valuable cabinet wood; hard and very dark, used for gun-carriages, etc.

Sal. (Shorea robusta. *Dipterocarpeae.*) Valuable timber of India. Exported.

Sandalwood. (Santalum album.) Mysore. Wood aromatic. See *Essential Oils.*

Satinwood. (Chloroxylon Swietenia. *Meliaceae.*) S. India and Ceylon. Beautifully marked, especially "Flowered satinwood," which is exported and valued at from 40*s.* to 50*s.* or more per cubic foot.

—, W. Indian. (Zanthoxylum flavum. *Rutaceae.*) Valued for cabinet-work, inlaying, turnery, etc.

Sissoo or Shishum-wood. (Dalbergia Sissoo.) Valuable timber of India.

Tamarind-wood. (Tamarindus indica.) Wood hard, dark-red, well-grained, esteemed for cabinet work, ornaments, etc.

Teak. (Tectona grandis. *Verbenaceae.*) Burma, Siam, etc. Tree gregarious, yields one of the most important commercial timbers of the tropics. Best teak considered to be produced on calcareous soil.

—, African. (Oldfieldia africana. *Euphorbiaceae.*) Sierra Leone.

Trincomalie Wood; Halmilla. (Berrya Ammonilla. *Tiliaceae.*) Ceylon, S. India, Burma. Wood tough and durable, formerly exported.

Tulip-wood, Australian. (Harpullia pendula. *Sapindaceae.*) Queensland.

Wallaba. (Eperua falcata. *Leguminosae.*) Large tree of Brit. Guiana. Wood hard, reddish-brown with pale streaks. Exported.

We-warani, *S*; Ranai, *T*. (Alseodaphne semecarpifolia. *Lauraceae.*) Ceylon dry region. Timber of commercial importance.

TIMBERS REASONABLY IMMUNE FROM TERMITES

Artocarpus integrifolia. Jak; Kos, *S*. **A. nobilis.** Wild Bread-fruit; Del, *S*.
Balanocarpus maximus. Chengal Penak. Malaya.
Bassia longifolia. Mi, *S*.
Berrya Ammonilla. Halmilla, *S*.
Brachylaena Hutchinsii. East Africa.
Bridelia retusa. Keta-kela, *S*.
Cassia siamea. Wa, *S*; Vakai, *T*.
Casuarina equisetifolia. Beef-wood; She-oak; Kasa, *S*.
Cedrela Toona and **C. odorata.** Cedar Wood.
Chloroxylon Swietenia. Satin-wood.
Doona zeylanica. Doon, *S*.
Dryobalanops aromatica. Malaya.
Eucalyptus leucoxylon. Iron-Bark. **E. robusta.** Swamp Mahogany. **E. marginata.** Jarrah.
Eusideroxylon Swageri. Billion.
Filicium decipiens. Pihimbiya, *S*.
Grevillea robusta. Silky-oak.
Hemicyclia sepiaria. Wira, *S*.
Hopea odorata. Thingam of Burma.
Mesua ferrea. Ceylon Iron-wood; Na, *S*. Hard and durable timber.
Mimusops hexandra. Palu. Hard and heavy.
Myroxylon Toluifera. Balsam-of-Tolu.
Pericopsis mooniana. Nedun, *S*.
Pterocarpus marsupium. Gammalu, *S*.
Swietenia macrophylla and S. Mahagoni. Mahogany.
Tamarindus indica. Tamarind.
Tectona grandis. Teak.
Terminalia glabra. Kumbuk, *S*.
Thespesia populnea. Tulip Tree.
Vitex altissima. Milla, *S*.

And many other hard or resinous woods.

CHAPTER XIX

RAILWAY-, SCHOOL-, AND REST-HOUSE GARDENS, AGRI-HORTICULTURAL SHOWS, ETC.

(1) *SELECTIONS FOR LOW, MEDIUM, AND HIGH ELEVATIONS.*
(2) *TREES FOR MEMORIAL PURPOSES.*
(3) *PLANTS FOR CEMETERIES.*
(4) *AGRI-HORTICULTURAL SHOWS:—*
(a) *ARRANGEMENT OF CATALOGUE.*
(b) *HINTS TO EXHIBITORS.*
(c) *RULES FOR JUDGING.*
(5) *JUDGING PLOTS OR FIELD CROPS.*

(For fuller information see Chapters IX and X.)

THE vicinity of railway stations, schools and rest-houses affords in many instances excellent opportunities of establishing attractive and useful little gardens, often in isolated or sparsely cultivated districts, capable of serving as object lessons to the peasantry, in addition to their primary purpose of ornament or utility. Through the agency of such gardens, useful and ornamental plants may be introduced and established, and opportunity afforded of demonstrating the kinds of plants or crops best adapted to the particular climate and soil of the locality. The most cheerless and bleak situation may thus be made attractive and interesting, while the effect of such gardens when well established in rendering a vicinity salubrious and agreeable can hardly be over-estimated.

In the case of school gardens especially, they serve (1) to train the children to habits of observation, and afford objects for nature study; (2) to relieve the routine of indoor with outdoor work of a pleasant nature and in the fresh air; (3) to cultivate a love of gardening; and (4) to teach the dignity of labour.

Laying-out and Planting. The outline of the garden having been decided on, the boundary should be planted with suitable trees for the purpose of providing shade or shelter. These should be planted closer than they are intended to remain when grown up, allowance being made for thinning out as the trees approach maturity. Deciduous trees should not, as a rule, be planted for shade, as they are likely to shed their leaves when shade is most required. It will help to make one's idea clear by first sketching on paper the general contour of the ground and the outline of the scheme it is proposed to follow, afterwards apportioning it off by means of string and pegs. The general plan should, of course, depend on the area, also on the labour available for maintaining the garden in a proper condition. Never make a garden larger than you can manage to maintain in good order. A small garden well kept is obviously preferable to a larger one which always presents an untidy or neglected appearance. Persons in charge of rest-houses and railway-gardens in Ceylon frequently make the mistake of supposing that a great number of miniature beds and borders, sometimes but a few inches in width, constitute an attractive garden. These are usually neither ornamental nor practical, being unsuitable for the growth

of most ornamental plants, and too small and intricate to allow of their being maintained in an attractive condition. A few simple beds of moderate dimensions, either oblong, round, or oval in shape, and borders of suitable width and graceful curves, set in turf, are therefore preferable.

Borders should, as a rule, be confined to the outskirts of the garden, and planted with tall shrubs so as to form a striking background for the beds of smaller plants in front. A few flower-beds may be dotted about the lawn and by the sides of paths, but care should be taken generally to leave the foreground as open as possible. Where only a narrow strip of ground is available, as at some railway stations, no elaborate design should be attempted; a bold border, 4–5 ft. wide, consisting of mixed ornamental shrubs in the back row and finishing with smaller plants in front, is in such cases the most practical and effective arrangement. The ideal small garden should present a striking background of tall shrubs and a few shade- or flowering-trees, with beds of gradually smaller plants in the foreground, set in a smooth lawn, with plenty of space between. This will present the best effect when looked at from the front, as from the railway carriages.

Paths should always be wide enough for two persons to walk comfortably abreast, or not less than 3 ft., and may be either straight or gracefully curved. It must be remembered that paths are meant for convenience rather than ornament; therefore avoid having more than are necessary. Cleanly kept, smooth and firmly rolled paths, of uniform width and with neatly trimmed edges, add, however, to the general effect of a garden.

Hedges. It is essential at the outset to afford protection against wandering cattle and, in some cases, also deer, porcupines, etc., by means of a wall, a paling of old sleepers or a barbed-wire fence; the latter may be concealed and beautified by showy climbers, or by a neat hedge of ornamental shrubs. A live fence or hedge of some formidable prickly plant (see *Hedges*) may afford an efficient barrier when well established.

Climbers. Ornamental climbers can be used with charming effect over bamboo, rustic, or iron arches; or they may be twined round tree trunks, or trained in festoons between pillars. They may also serve useful purposes in screening off an unsightly outhouse or shading an exposed verandah. Climbers, however, may be injurious to buildings if allowed to grow unchecked over the roof, and should therefore be kept within proper limits.

Lawn forms the best setting for beds and, if well kept, will not only enhance the ornamental effect of the plants, but will in itself present a very pleasing appearance. A lawn is easily produced, and when once made entails less labour in upkeep than if the same area were laid out in numerous paths and beds (see *Lawns*). The grass may be kept short simply by means of a bamboo splint or a piece of sharp-edged hoop-iron, if a lawn-mower is not available.

Upkeep. However well a garden may be laid out and planted, its success will depend upon proper upkeep. It may be accepted as a general rule that its condition invariably reflects the extent of personal interest of its owner or the person in charge. Keeping the grass short and the turf uniformly level, the paths clean-weeded, with neatly cut edges, hedges neatly trimmed, weeding, forking, and mulching the soil—these are operations which should never be neglected, and go far to make a perfect garden.

Propagation, as by cuttings, bulbs, division of roots, etc., may easily be carried out in small gardens, as at railway stations, rest-houses and schools. Too often, valuable plants are neglected and allowed to run out of stock, the Government Gardens being expected to replace them when required. All that is necessary is a bed of loose, rich soil in a shady corner, with water near at hand for watering when required. The ground should be dug about 1½–2 ft. deep, so as to afford good drainage, encourage the retention of moisture in the soil during dry weather, and enable growing roots to penetrate through it. Remove coarse stones, etc., and place on the surface a layer of fine soil, adding some leaf-mould or well decomposed manure, and a little fine river-sand if the soil is of a clayey nature.

Shading and watering the beds when necessary, or protecting them from excessive rain, etc., must be attended to. The advantages of having one's own nursery are obvious, for not only are plants thus ready at hand when required for planting out or for filling vacancies, but the supply of special kinds suitable for definite purposes or locality can be relied on.

SELECTIONS FOR DIFFERENT ELEVATIONS

(See also pages 102–200.)

Flowering and Foliage Shrubs:

Sea Level — 2,500 Ft.

Lagerstroemia indica. Indian Lilac.
Tabernaemontana coronaria. Wax-flower. Fls. pure white.
Croton. Different vars. Ornamental lvs.
Palms. Different vars. Handsome foliage.
Acalypha. Different vars.; large, coloured lvs.
Pisonia alba. Lettuce-tree. Greenish-yellow foliage.
Arundo Donax. Large, variegated grass.
Hibiscus. Different vars. Showy fls.
Amomum magnificum. Large ornamental lvs.
Poinsettia pulcherrima. Showy scarlet bracts.
Heliconia aureo-striata. Large, ornamental, plantain-like lvs.
Panax fruticosum. Feathery lvs.
Cordyline (Dracaena). Large, purple, crimson or bronze lvs.
Aralia filicifolia. Feathery foliage.
Mussaenda erythrophylla. Showy scarlet fls. (enlarged sepal of each).
Gardenia florida. White, scented fls.
Kopsia fruticosa. Pink-and-white fls.
Plumeria rubra. Red Temple-tree.

Climbers:

Solanum Wendlandii. Large blue fls.
Allamanda Hendersoni. Large, yellow, bell-shaped fls.
Bignonia venusta. Deep orange-yellow.
Antigonon leptopus. Lovely pink fls.
Clerodendron Thomsonae. Beautiful white and scarlet fls.
Petrea volubilis. Beautiful blue and violet fls.
Congea tomentosa. Showy pink sprays.
Ipomoea Briggsii. Dark crimson fls.
Bignonia venusta. Tanga-poo. Fls. orange-yellow.
Solanum seaforthianum. Blue fls.

Showy Flowering Annuals:

3,500 Ft.

Acroclinium and other "Everlastings."
Asters, Balsams, Browallia, Celosia.
Chrysanthemums (Annual).
Clarkia. Pink fls.
Candytuft. White or purple.
Coreopsis. Bright yellow.
Cosmos. Bright orange.
Dianthus. Indian Pink.
Exacum macranthum (*q.v.*).
Hollyhock, single or double.
Larkspur, Linaria, Linum.
Mignonette. Nemesia, 6–8 in. high.
Nicotiana, different vars.
Petunia; Phlox Drummondi; Poppies.
Portulaca or "Sun-plant"; dwarf.
Salpiglossus, Schizanthus, Verbena, Zinnia.

Low Plants for Beds, Front Rows, or Edging:

Canna. Numerous vars. See *Bulbs*.
Vinca rosea. Pink or white fls.
Coleus. Different vars.; ornamental lvs.
Caladiums. Different vars. See *Bulbs*.
Alternanthera. Several vars. Dwarf plants, useful for edging and designs.
Coreopsis. Yellow fls.; biennial.
Ageratum. Blue fls.; annual.
Angelonia. Bluish-purple or white fls.
Cosmos. Pink and white fls.
Ananas variegata. Variegated pine-apple.
Turnera elegans. Creamy-white fls.
Gynandropsis. Large pink sprays.
Torenia Fournieri. Small plant, violet and blue fls.; also a white var.
Chrysanthemum. Perennial. White, yellow, purple, etc.
Gomphrena globosa. Purple fls.
Phrynium variegatum. Variegated lvs.
Salvia farinacea. Pale blue fls.
Pentas carnea. Pink, mauve, white, etc.
Ruellia colorata. Purple bronzy lvs.
Salvia. Scarlet fls.; very showy.
Cuphea jorullensis. Fls. orange-yellow.
Marigolds. Fls. yellow, orange, etc.

Flowering and Foliage Shrubs:

Pavetta indica. Fls. white.
Russelia juncea. Fls. pink.
Sanchezia nobilis. Variegated lvs.
Strobilanthes coloratus. Fls. dark purple.
Montanoa bipinnatifida. Tree-daisy.
Graptophyllum vars. Variegated fol.
Tecoma stans. Yellow fls.
Beloperone oblongata. Pink fls.
Duranta Plumieri. Blue fls.
Plumbago capensis. Pale blue fls.
Pleroma macranthum (*q.v.*).
Musa coccinea. Flowering-banana.
Streptosolen Jamesoni. Fire-bush.
Brunfelsia Hopeana. Blue and white fls.

Tuberous and Perennial Plants, etc.

Agapanthus umbellatus. Lovely blue fls. in large heads.
Aster, perennial. Different shades.
Cannas. Yellow, scarlet, pink, etc.
Cyrtanthus. White or pink, scented.
Dahlias. Purple, yellow, scarlet, etc.
Hedychium coronarium. White.
Heliotrope. Blue, mauve, etc.
Hippeastrum. Different vars.; large showy fls.
Hydrangea. Fls. blue, white, or pink.
Iresine. Crimson variegated lvs.
Ixia pendula. Orange-yellow.
Roses, which see.
Tritonia aurea. Orange-yellow.
Vinca (Periwinkle). Blue or white.

Shrubs and Herb. Perennials:

6,000 Ft.

Anchusa, vars. Hp. Bright blue.
Azalea, different vars.; pink, white, etc.
Brunfelsia Hopeana. Blue and white.
Cestrum (Habrothamnus) elegans. Bears bright crimson berries.
Datura fastuosa. Fls. large, white.
Fuchsia arborescens. Showy lilac fls.
Libonia floribunda. Orange-red fls.
Salvia. Different vars.
Spiraea peruviana. Creamy-white fls.

Pot-, Border-Plants, Etc.

Cineraria. Blue, white, etc. (For pots.)
C. maritima. Glaucous lvs.; for borders.
Chrysanthemums. White, yellow, etc.
Daisies. White, scarlet, etc.
Geraniums. Scarlet, pink, white, etc.
Michaelmas Daisy. Blue, pink, etc.
Pansies. Different colours.
Santolina. Cotton Lavender. Grey cottony foliage, scented.
Sweet Peas. Various shades (*q.v.*).
Violets. Blue, violet, purple, white.

Ornamental Climbers:

Bignonia venusta (*q.v.*).
Cobaea scandens. Strong grower; fls. bell-shaped, purplish-white.
Mandevillea suaveolens. Chile Jasmine.
Solanum jasminoides. Fls. white, showy.
Tacsonia. Tubular, pink, drooping fls.
Thunbergia wightiana. Fls. half yellow and half brown.
Tropaeolum (Nasturtium). Fls. yellow, orange, etc.
Wistaria sinensis. Bears clusters of beautiful blue and pale purple fls.

TREES FOR MEMORIAL PURPOSES

(For descriptions see *Flowering-* or *Foliage-Trees*.)

(A) For the Moist Low-country

Fine Flowering Trees:

Amherstia nobilis.
Brownea grandiceps. B. macrophylla.
Cassia grandis. C. nodosa.
Couroupita guianensis. Cannon-ball Tree.
Jacaranda mimosaefolia.
Lagerstroemia Flos-Reginae.
Mesua ferrea. Ceylon Iron-wood.
Peltophorum ferrugineum.
Plumeria rubra. Red Temple Tree.
Poinciana regia. Flamboyante.
Schizolobium excelsum.
Spathodea campanulata.

Handsome Foliage Trees:

Agathis robusta.
Araucaria Bidwellii.
Artocarpus incisa. Bread-fruit.
Bertholletia excelsa. Brazil-nut Tree.
Chrysophyllum Cainito. Star Apple.
Enterolobium cyclocarpum.
Fagraea fragrans. Tembusu.
Ficus Benjamina. Java Willow.
Parkia Roxburghii.
Podocarpus cupressinus.
Pterocarpus indicus.
Swietenia Mahagoni. Mahogany.

(B) For Dry Region:

Cassia Fistula. Indian Laburnum.
Millingtonia hortensis (*q.v.*).
Plumeria acutifolia. Temple Tree.
P. rubra. Red Temple Tree.
Polyalthia longifolia.
Tamarindus indica. Tamarind.

(C) For Up-country:

Araucaria Bidwellii.
Cupressus, and other Coniferae.
Frenela rhomboidea.
Grevillea robusta.
Stenocarpus sinuatus.
Syncarpia laurifolia.

PLANTS FOR CEMETERIES

Dwarf or slow-growing plants, which are evergreen and have fine graceful foliage, or bear white, blue or pink flowers, are usually preferred for planting on or around graves. Tall or quick-growing trees or shrubs are seldom suitable, except perhaps in a young state and for later removal. The following are suggested for the purpose.

For Low-country:

Feathery-leaved palms, as **Chrysalidocarpus**, **Ptychosperma**, **Areca**, etc., and small plants of slow-growing trees or shbs., especially those with a drooping habit, such as **Cupressus funebris** (Weeping Cypress), **Casuarina** in young state, **Cycads**

(Madu), **Schinus molle**, **Plumeria acutifolia** (White Temple Tree), **Thuja orientalis** (Arbor Vitae), etc. Small shbs. with white or blue fls., as **Angelonia** (white or blue); **Brunfelsia** (blue or cream); **Plumbago capensis** (blue or white); **Salvia farinacea** (pale blue); **Vinca alba** (annual. white-fld. var.); **Wrightia zeylanica** (fls. snowy white).

Dwarf or Edging Plants:

Alternanthera (foliage green, yellow, or bronze); **Caladium argyrites** (small variegated white and green lvs.); **Coleus** (handsome, velvety, variously coloured lvs.); **Ophiopogon** (creamy-white fls.); **Phalaris arundinacea** (variegated dwarf grass), **Pilea muscosa** (dwarf moss-like plant); **Zephyranthes** (white tubular fls.), and other bulbous plants.

For Up-country:

Alternanthera (see above); **Amaryllis** (different vars.); **Dwarf Begonias**; **Carnations**; **Coleus** (see above), **Cyrtanthus** (white fls.), **Hydrangea** (white, blue or pink), **Santolina** or "Cotton Lavender" (greyish-white scented foliage); **Dianthus** or "Sweet William" (white or pink fls.); **Tuberose** (white, scented fls.), various other bulbous plants and annuals.

AGRI-HORTICULTURAL SHOWS

Rules for Judging, Hints for Managing Committees and for Exhibitors.

(A) *ARRANGEMENT OF CATALOGUE OR PRIZE-LIST.*

(1) The catalogue or prize-list should be drafted, or at least passed, by a person or persons of experience. It should be arranged in *Sections* and *Classes*, the latter being numbered in sequence, at the left-hand margin.

(2) Indefinite or ambiguous terms, as "sub-classes," "divisions," and "sub-divisions," should be avoided.

(3) Special conditions affecting a Section or Class should be indicated at the heading of such section or class, or as footnotes.

(4) Prizes should not be offered for flowers or crops which are not likely to be in season at the time of the Show, for this only limits the prizes which would be available for other classes, or may result in bringing forward only inferior specimens.

(5) Discretion is necessary in stating the quantity or numbers required for an exhibit. These should be just sufficient to form representative samples, and no more. An example of what should be avoided is: "Best collection of varieties of paddy," instead of "Best collection of, say, 20 distinct varieties." The number of so-called varieties of rice is practically unlimited.

(6) Descriptions of classes should be definite and incapable of misinterpretation. For instance, "species" should not be referred to when "variety" is meant, or *vice versa*. Ambiguous terms should be avoided—*e.g.* "Lilies," a popular term of uncertain definition, generally implying plants of Amaryllideae, Liliaceae, Irideae, Aroideae, etc. This is a frequent cause of misunderstanding at Shows. If the term *Lilium* only is not implied it should be stated thus: "Lilies, including *Liliaceae*," etc.

(7) A distinction should be made when practicable between market-gardeners (or nurserymen) and amateurs, providing separate classes for these.

(8) Prize-cards and rosettes should be of uniform sizes and colours, according to their respective value, for all classes in the Show. Thus, first-prize cards should be red; second-prize, blue; and third or "highly commended," lavender or yellow.

(9) It is important that the staging provided for the cut-flower class or other exhibits necessitating the use of vases or other vessels containing water, should have a level, boarded surface. Flimsy and uneven staging is very unsatisfactory.

(10) Definite positions and spaces should be allotted and prominently labelled for the different classes before the exhibits are received. The Managing Committee should see that the allotted spaces are in charge of persons who will attend to placing the exhibits in their correct positions.

(11) Fruits or other exhibits which have an objectionable odour, such as durian, especially when cut open for judging, should not be placed among the more attractive exhibits, but confined to an isolated corner or shed.

(12) The Managing Committee should aim at arranging the classes as nearly as possible in the sequence in which they are given in the catalogue.

(B) *HINTS TO EXHIBITORS.*

Preparation and arrangement of exhibits.

(1) Intending exhibitors should sow or plant crops of vegetables, flowers, etc., in time to allow these to mature and be at their best at the date of the Show. The period required in each case will vary according to kind, locality, climate and soil. One is best guided by experience in this respect.

(2) Should the specimen ripen a little too early or a little late, a resourceful cultivator can adopt measures which will to some extent retard or hasten the process, as by protecting artificially from excessive rain or sun, checking growth by making a cut in the stem, as with lettuce, cabbage, cauliflower, etc., or hastening it with applications of liquid manure or nitrate of soda. Flowers may be kept back by nipping the earlier blooms, or they may be advanced by affording protection from rain by means of a sheet of glass or a disc of tin or cardboard placed over them.

(3) Greater size and quality may be induced in flowers or fruit by a judicious thinning out, always retaining the best formed bunches or individuals. Sufficient growing space is essential for the best development of any crop, whether fruit, flowers, or vegetables.

(4) In selecting exhibits, adhere to the rules laid down in the catalogue, especially in regard to the number or quantity required; disregard of these may disqualify an exhibit, whatever its merits. Rules are made to be observed and as a necessary guidance for the judges.

(5) Wash root-crops carefully and cut off unnecessary roots before sending to the Show.

(6) Support the stems of flowering plants in pots, but avoid obtrusive stakes or ties, which should as far as possible be invisible. Do not use pots that are too large or out of proportion to the size of the plants; see that all pots are scrubbed clean.

(7) Remember that *quality* counts for more than quantity, that vegetables, fruits and other edible products should be in their best state for consumption when exhibited. Overgrown vegetables are generally unfit for eating. Fruit should be just ripe; if unripe or over-ripe, it is unfit for judging. Uniformity is also an important point.

(8) Solitary flowers, such as Roses, Hibiscus, etc., for exhibition should, after they are cut, be kept intact by tying a soft piece of wool or cotton around each. This of course must be removed by the exhibitor before the judging commences. Cut flowers of any kind should have their stalks placed in water immediately after cutting; these will keep longer if, when being trimmed, their stalks are cut under the water instead of in the air. All flowers should of course be cut in the early morning or, if this is not practicable, late in the evening before the Show.

(9) An important point is that the exhibit as a whole should present a uniform appearance or quality, *i.e.* it should be a "good sample."

(10) In transporting delicate fruits, such as mango, papaw, sapodilla, tomatoes, etc., they should be packed with fine shavings, sawdust, or some soft material to prevent them from being bruised. Smaller fruits, as uguressa, strawberries, purple guava, etc., may be packed in layers with a large leaf between each layer. Large fruits, such as plantains, pineapples, durians, jak, etc., should be packed with dry straw or shavings, in crates or well-ventilated boxes.

(11) Plants, if sent over a long journey, should be packed in crates, the stems, flowers, or leaves being securely tied and held in position. Flowering plants in bloom should have each stem staked separately. Pots or tubs should be well wrapped in straw or shavings, and bound round so as to prevent the soil from being shaken or tipped out.

(12) Lids of cases should be screwed down (not nailed); or, better still, hinged and

locked with a padlock. Packages sent by rail or other public conveyance should be addressed clearly and marked *Urgent*; when closed, the top should be marked *This side up*, and *Fragile*, especially when containing glass jars or breakables.

(13) Fruits, vegetables, herbs, etc., may be exhibited in shallow basket-trays or on plates of uniform sizes. Small fruits, as grapes, strawberries, guavas, etc., are rendered more effective by having a few of their own leaves arranged neatly around them.

(14) Do not stage small articles in large and unsightly receptacles. In England, regulation dishes or plates are sometimes lent on the Show ground by the Committee at a small charge.

(15) The educational value of an exhibit may be enhanced by having a neatly written label attached to it, giving the common, and if possible the botanical, name of the exhibit, whether stated in the catalogue or not, also any other information in brief.

(16) Flowers which naturally grow in clusters, such as Verbena, Phlox, Schizanthus, etc., are best shown in bunches, while blooms of a large size and distinctive form, *e.g.* Dahlias, Roses, Hibiscus, etc., are seen to best advantage when displayed singly.

(17) Though bottles or tins, if of uniform size and securely held in position, may answer the purpose of displaying cut-flowers, the correct article to use in order to display these to the best effect and facilitate arrangement, is an *exhibition box*. This may be made of any light wood, and painted green; it should have a sloping top, on the principle of a writing-desk when open.

(18) Above all, note carefully and observe strictly the conditions laid down in the catalogue in regard to the number or quantity required, time for receiving exhibits and completing arrangements, commencement of judging, etc.

(19) The exhibitor's name should be given on a card or slip of paper inside an envelope attached to the exhibit, and should on no account be exposed to view until after the judging.

(C) *RULES FOR JUDGING.*

(1) Persons selected to act as judges should possess a practical knowledge of the classes they are to judge, not only of the crops as they appear on the market, but also, if possible, of their cultivation.

(2) No judge should have private interest in the class or classes in which he or she officiates.

(3) It is usually advisable, especially where exhibits are fairly extensive and competition is close, to appoint three judges to form a quorum, either for each section or for a group of classes.

(4) First dismiss from consideration all exhibits which are manifestly inferior; then compare those which remain. In the case of close contest, proceed to judge by points, *i.e.* awarding a definite number of marks out of a possible maximum to the principal points of merit. The possible maximum may be agreed upon according to the number of points considered desirable in the exhibit. Thus, fruits and vegetables may be allotted a maximum of ten marks each on the following points: quality, shape, uniformity, colour, size, and condition for consumption; while with flowers, size, colour, condition and form would be the principal points of merit. Effective arrangement and correct naming may also be taken into consideration and awarded marks. It is not necessary to resort to points when the exhibits show unmistakable differences in quality.

(5) The judges should not disclose the name of the exhibitor until their decision has been arrived at, after which the envelope attached must be opened, and the exhibitor's name, award, class, and description of article written on the prize-card.

(6) Exhibits should as a rule have been grown by the exhibitor or his employer for at least two months before the Show, unless stated to the contrary in the catalogue. This rule need not apply to flowers for table decoration. The common practice, in the tropics, of purchasing produce from villagers and exhibiting this in the purchaser's name in a competition should be condemned.

(7) Judges should, if possible, adhere strictly to the rules and conditions laid down in the catalogue, except perhaps where an obvious mistake or oversight necessitates a departure. Otherwise disputes are liable to arise.

(8) The judging should always be done as punctually as possible and before the public are admitted to the Show. Frequently the judges have too much to do in the allotted time, which must result in their work being unduly hurried, or its being delayed until it has to be carried out in the presence of the public, which is very unsatisfactory.

(9) Each set of judges should be provided with an interleaved copy of the catalogue, the interleaf being ruled to correspond with the printed prize-list opposite. One judge should write down the winners, while another writes the prize-card. The latter should be filled in and fastened to the exhibit at the time the award is made.

(10) The judges' lists of awards should be handed in to the Secretary personally, when they should at once be placed in a secure place.

(5) HINTS FOR JUDGING PLOTS OR FIELD WORK

In the case of plot or field work, it is especially necessary to adopt the system of judging by points, and in order to facilitate correct valuation it is convenient to take 10 or its multiple as the maximum award for each point. The number of points considered should not be unnecessarily increased, five being usually sufficient. Thus:

(1) Condition and uniformity of crops.
(2) Cultivation and tilth.
(3) Regularity of lines and spacing.
(4) Tidiness and freedom from weeds.
(5) Healthiness and freedom from pests.

To these, other points may be added according to circumstances, such as variety, selection, labelling, etc.

SECTION III

CHAPTER XX

FRUIT CULTURE

ALTHOUGH certain tropical fruits are unsurpassed for their lusciousness, *e.g.* the pineapple, banana, mango and orange, the great majority have, in contrast to fruits of temperate countries, undergone but little improvement at the hands of the cultivator or plant-breeder. That many are, nevertheless, capable of considerable improvement by high cultivation and selective propagation, as by budding, grafting, layering, etc., or by hybridisation and cross-breeding, cannot be doubted. Fruit-growing in the tropics often follows the line of least resistance, and seed-propagation is generally adopted when this entails the least trouble.

Vegetative and Selective Propagation is essential as a means of standardising chosen varieties. Briefly, it consists in carefully selecting individuals or types (clones) with specially desired qualities, and the raising of these by vegetative means. Sexual or seed propagation cannot be relied upon to produce fruits true to type and of uniform quality. An exception may be stated in the case of the polyembryonic seeds of the Mango, Orange, etc., in which embryos arise as adventitious buds of the nucellar tissue without fertilisation. Improvement methods in fruit culture should aim at developing such qualities as flavour, size, shape, colour, aroma, freedom from fibre and acidity, few or no seeds. Tropical fruits are sometimes marred by an objectionable odour, *e.g.* durian, which it is desired should be eliminated by hybridisation.

Fruit-growing for market. In recent years fruit-growing on commercial lines has made important progress in some tropical and sub-tropical countries, as for example the pineapple industry in Hawaii, Porto Rico, Cuba, Singapore, etc.; bananas, oranges and grape-fruit in the W. Indies; oranges, grape-fruit, figs, etc., in California and S. Africa; and grapes, peaches, apples, etc., in Australia. Owing to the recent development of cold storage on sea and land, as well as of the canning industry, such fruits now successfully compete in markets thousands of miles distant. There still remain, however, apart from local demand, possibilities of certain tropical fruits supplying foreign markets. Such fruits as mangoes, mangosteens, papaws, avocado-pear and sapodilla, for example, are as yet but little known outside the tropics. A great drawback of many tropical fruits is their poor keeping qualities. Fruit-growing in Ceylon has hitherto been limited to local requirements, and carried on in a rather haphazard manner, owing partly, no doubt, to causes incidental to the tropics generally, one of which is the difficulty of

protecting the crops when approaching ripeness. (See *Garden and Estate Enemies.*)

Pruning. For most fruit-trees, pruning in some form is indispensable, as on it depends largely the continuance of yield, quality of fruit, and the maintenance of the trees or bushes in regular shape and accessible form, which facilitates the harvesting of the crop. The correct degree of pruning varies according to kind and individual specimen. In the case of evergreen trees, as the Mangosteen, Mango, Avocado, Durian, etc., little or no regular pruning is necessary beyond periodical thinning out and removal of weakly or dead portions of wood, admitting light to all parts of the tree. (See *Pruning.*)

Time to Prune. No hard and fast rule can be laid down with regard to time for pruning in the tropics. Generally speaking, the proper time is after the crop is over and before blossoming commences. It should be carried out before the flush of new growth, which usually occurs twice a year, but varies according to the dry or rainy seasons, and even in individual trees. In the south-west part of Ceylon the flush- or new-growth seasons are usually March–April and September–October. In the tropics generally, where most trees are practically evergreen and growth is continuous, it is difficult to prescribe a definite pruning season. Periods of severe drought should be avoided for pruning of any kind, as should also the flush-season, when there is risk of bleeding from wounds.

Manuring and cultivation have, of course, a most important effect not only on yield but also on the quality of fruits. Organic or cattle manure is the most lasting, but certain artificial manures have very marked results and are especially conducive to fruitfulness. A potash mixture (see *Fertilisers*) is usually recommended for fruit-producing crops. Such a mixture may be applied at the rate of ¼ lb. each for young trees, up to 4 lb. or more for mature trees, forking it in in a circle round the stem, but not too close to it. Surface roots should not be cut or injured more than necessary, so that the soil should not be turned over if the surface is occupied with roots. Fruit-trees do not usually thrive in grass land; therefore cultivation of the soil is generally regarded as essential. An unfruitful tree may sometimes be induced to bear fruit by cutting a deep circular trench round it, about 6 ft. from the stem, applying a dressing of fertiliser to the top soil. This may also serve the purpose of *root-pruning* (*q.v.*).

Climate, etc. A dry rather than wet climate is generally best for the production of fruit crops, with perhaps few exceptions, *e.g.* the mangosteen and durian. A dry atmosphere favours the setting of fruit as well as their ripening and colouring, while it also facilitates harvesting, transport, storing, etc. Means for watering or irrigation should be available, so that water may be given or withheld as desired. Thus the control of moisture is an important factor in fruit-growing.

SELECTED TROPICAL FRUITS FOR LOW OR MEDIUM ELEVATIONS

(See also *Recipes for Jams, Preserves*, etc. *S* = Sinhalese; *T* = Tamil.)

Achras Sapota. Sapodilla-plum: Zapote; Bully-tree; Naseberry; Chikku or Chico; Rata-mi, *S*; Shimai-eluppai, *T*. *Sapotaceae* or Gutta family. A small or medium-sized symmetrical tree, 20–30 ft. high, with dark green, shining, leathery leaves, native of Trop. America and W. Indies; introduced to Ceylon about 1802, but as yet only occasionally cultivated here, chiefly in the Kalutara and Galle districts. The round or ovoid, russet-brown, thin-skinned fruit contains when fully ripe a mass of pale brown, soft, luscious pulp, in which the large black shining seeds are embedded.

Firminger wrote: "A more luscious, cool and agreeable fruit is not to be met with perhaps in any country in the world." It is not, however, relished by every-one, and unless perfectly ripe is unfit for eating, owing to its gummy consistency.

The tree is commonly cultivated in Lower Bengal, the Philippines, etc., and thrives up to 3,000 ft. In Ceylon it succeeds best at low elevations in the wet zone. It is a slow grower, and may be propagated by seed, but preferably by grafting; usually bears two crops a year, viz. during August–September and February–March. In India the fruit is sometimes erroneously called "mangosteen." There are several varieties, differing in size and form of fruit. (See *Chickle Gum.*)

SAPODILLA (*Achras Sapota*).

Ananas sativus. Pineapple; Annasi, *S. Bromeliaceae.* A perennial stemless plant, with long, narrow, fibrous and usually spiny leaves, native of Trop. America, introduced into all warm countries, sometimes cultivated on extensive commercial lines, as in Hawaii, Cuba, the W. Indies, Formosa, Singapore, Queensland, etc. Among fruits of the tropics, this must be considered to take first place. It is borne on an erect, stout stalk issuing from the centre of the plant; the latter dies after maturing the fruit, and is usually reproduced by suckers (ratoons) from the base. Pineapples thrive in Ceylon from sea-level to about 3,000 ft., or higher in sheltered situations. The plants are naturally suited to a rather dry climate, but flourish also in moist and hot districts, provided the land is naturally well drained. They thrive best in rich, humous or loamy and well-drained soil. Virgin or jungle soil, under light shade, generally yields the largest and most luscious fruits. Permanent shade, however, is not essential except at low elevations and in dry sandy soil. Botanically, the fruit is a *sorosis*, resulting from a number of flowers, these being represented in the mature fruit by the "eyes."

PLANTATION OF KEW PINES IN EAST AFRICA.

Cultivation. Propagation is by offsets or "slips," which should have the lower leaves trimmed off for a length of 1½ or 2 in. Crowns from the fruit may also be used, but these take 2 years or more to come into bearing, whereas good strong mature suckers should bear fruit within 15–18 months from planting, according to climate and cultivation; cropping is earlier at low elevations. The ground being well tilled, the suckers may be planted out either in single rows about 4 ft. by 2½ ft.; or in double or treble rows at distances of 5 ft., with about 2 ft. between the rows as well as between the plants in the rows. The former method has the advantage of facilitating weeding and cultivation, while in the double- or treble-row system better support for the fruit as well as economy of space is obtained. In Hawaii a spacing of 3 × 2 ft., in single rows, is generally preferred. Close planting results in rapid ground-cover and, therefore, in suppression of weeds.

Replanting, Manuring, etc. Replanting is usually necessary after 3–4 years, ratoon crops being obtained from suckers after the original plants have fruited. Due attention must be paid to thinning out of superfluous suckers, removal of stumps which have fruited, and manuring. In some cases plantations may last for 6–8 years without renewal. A change of site should, as a rule, be given when replanting, though with systematic cultivation and manuring continuous cropping in the same ground is possible. With good cultivation vacancies or blanks should not exceed 10 per cent. Manuring is essential, applications of organic matter being especially necessary. A fertiliser mixture consisting of potash, nitrate of soda and bone meal is recommended.

CUSTARD APPLE (*Anona squamosa*).

Yield. As already stated, plants take from 1 to 1½ years to come into bearing, being earliest at low elevations. Cropping is spread over the greater part of the year, except perhaps during a prolonged wet season. The fruits vary in weight from about 4–14 lb. each (see below); for market purposes an average size of 6–8 lb. is preferred. In Hawaii an average yield of 10–12 tons of fruit per acre is recorded.

Varieties. A number of varieties are recognised, many differing but little or are merely known by different names. One of the best and most distinct is the Smooth Cayenne, commonly known as Kew Pine, a large, luscious, juicy fruit with yellowish flesh, often weighing from 12 to 14 lb., sometimes 16 or even 20 lb. or more. This variety has the additional merit of having spineless leaves, thus facilitating cultivation and harvesting. It is extensively cultivated in Hawaii, Florida, Azores, etc., and usually commands the highest price in the London market. Red Spanish is a favourite in the W. Indies and is noted for its sweetness. Other leading varieties are Sugar-loaf, Ruby, Ripley Queen, Black Antigua, Pernambuco, Bracomorensis, Abbaka and Egyptian Queen. In Ceylon the Mauritius (Ripley Queen) occurs in two types, (*a*) reddish-yellow, and (*b*) yellow when ripe. This appears to be identical with what is known as "Ceylon" in the W. Indies. Rock Pineapple (Gal-annasi, *S*) is a semi-wild variety in Ceylon, bearing small, yellow, inferior fruits.

Anona squamosa. Custard-apple of India, etc.; Sweet-sop; Anoda, *S. Anonaceae.* A small tree, native of Trop. America, commonly cultivated throughout the tropics. The fruit is of the size of a large apple and has a peculiar rind, which has the appearance of being formed of scales; when ripe, these break away separately, exposing the white, granular, sweet, custard-like pulp. The principal seasons in Ceylon are

April and October, when the fruits are commonly sold in the markets. The tree thrives in ordinary, well-drained soil, up to about 3,500 ft. In India the fruit is said to be grown to perfection in the neighbourhood of Cawnpore, " thriving in the most barren and sterile places." But good cultivation naturally produces better fruit. A purple-fruited variety is sometimes met with in the W. Indies.

Bertholletia excelsa. Brazil-nut; Savory-nut; Para-nut. *Lecythideae.* A tall handsome tree, with long, wavy, pointed leaves, 14–16 in. long and about 3 in. broad, native of Guiana, Venezuela and Brazil, being found chiefly in the State of Para. In its native home, especially on the banks of the Amazon and Orinoco, it attains a height of considerably over 100 ft. Introduced at Peradeniya in 1880, it fruited for the first time in 1906. The same tree is now about 70 ft. high, and produces at the ends of the upper branches each year, in the dry season, large erect panicles of white flowers, followed by large, brown, round or ovoid fruits, which take about 8 or 9 months to ripen. Ridley records similar progress of a Brazil-nut tree at Singapore, where it was introduced in 1881.

Brazil Nut (*Bertholletia excelsa*).
(1) Flowering branch (flowers dropped); (2) whole fruit; (3) fruit sawn open, showing nuts; (4) woody plug.

Normally the tree takes 15 years or more to bear fruit. The latter is a hard, woody, brown shell, from 4 to 6 in. in diameter, enclosing from 12 to 15 or more large, angular, closely packed nuts (seeds), each with a brown horny testa; these are the " Brazil-nuts " of commerce, which form an important article of export from Brazil. At the top end of the fruit is a small aperture (fitted with a woody peg), too narrow to allow access to the " nuts," which are therefore secure from animals; consequently the shell has to be sawn, or broken with an axe, in order to obtain the nuts. Propagated by seed or gootee, and thrives best on a rich, deep, alluvial soil, in a hot and moist climate.

Carica Papaya. Papaw; Papaya; Papeta; Tree-melon; Pepol, *S*; Pappali, *T*. *Caricaceae*, Passion-fruit family. A fast-growing, small, herbaceous, branchless and usually dioecious tree, attaining a height of about 15–20 ft., indigenous to Cent. America and the W. Indies, cultivated throughout the tropics. It bears a crown of very large, handsome, palmate leaves, at the base of which the large green and closely packed fruits are produced. The latter vary from round to ovoid or oblong in shape, being usually 8–14 in. long by 4–6 in. in diameter, not unlike green melons in appearance and texture, each weighing from 5 to 8 lb. or more. They are in season all the year round.

The fruit has a central cavity, to the walls of which the olive-coloured seeds are attached, usually in great abundance, but sometimes few or none. The succulent flesh is of a pinkish or orange tint, very refreshing and agreeable to the taste, especially on first acquaintance. It is generally

esteemed as a table fruit, and is considered an aid to digestion. Some people prefer to eat it with a little sugar and fresh lemon or lime-juice. It may also be made into jam or sauce, and in the unripe state may be pickled, or boiled and used as a vegetable. The fleshy seeds have a flavour like that of water-cress.

Papaine, a digestive enzyme, valued in medicine and in the preparation of chewing gums, etc., is obtained from the white, thin latex or juice. The latter is extracted by making slight incisions with a bone knife or wooden splinter in the unripe fruit; the juice rapidly exudes from the cuts and is collected in a cup held beneath, then spread on glass to dry in the sun or, if the weather be wet, over a stove or in a hot-air chamber. Drying should be effected without delay, but should not be too rapid, a temperature of about 100° F. being recommended.

The process should be completed in about 24 hours. When the material is crisp-dry, it is reduced to a fine powder, or made into a granular form, like vermicelli. It is then of a greyish colour and has an unpleasant odour. It should be packed in hermetically-sealed tins or bottles for export. About 5–8 oz. dried papaine may be obtained per tree in a year, or an average of about 150 lb. per acre. The fruits may be tapped at intervals of 2 or 3 days, and are not removed from the tree until they cease to yield latex. Fair to good quality papaine formerly fetched from 6*s*. to 10*s*. per lb., but the demand is limited and irregular. Papaine, as already stated, is used in medicine, in invalids' and children's foods, and in chewing-gums, etc. The property of Papaw leaves in rendering meat tender is well known, and is commonly made use of by native cooks, who wrap the leaves round fresh meat, or place a piece of the green fruit in the water in which the meat is boiled. 128,463 lb. of papaine, valued at £44,956, were exported from Ceylon in 1929.

Papaw (*Carica Papaya*).
Showing fruit whole and in section.

Cultivation, etc. The Papaw tree likes deep, humous or loamy soil, and flat or gently sloping land, which should be well manured. Planting distances may be about 6 or 7 ft. each way. Seeds may be sown at stake, allowing 5–6 to each hole, afterwards retaining one good seedling only; or seedlings may be raised in bamboo-pots and planted out when a few inches high. The tree thrives from sea-level to about 3,000 ft. in moist districts; bears fruit continuously from the time it is about 10 or 12 months old, but deteriorates and becomes unprofitable at the age of 3 or 4 years. It is very prolific when in its prime, when as many as 50 fruits in various stages of development may be counted on one tree at a time, but in a plantation the average crop per tree may be about 55 or 60 fruits per annum.

Being usually dioecious, the tree is dependent on cross-fertilisation for its reproduction by seed. Therefore the varieties become much mixed, the fruit varying from globose to long and narrow, with many, few, or no seeds. Roundish fruits with few seeds are often the best flavoured. Occasionally, bisexual (hermaphrodite) flowers are produced by either male or female trees. Thus " male " trees sometimes bear fruit, which, however, are usually small, in pendulous clusters. When

"male" trees are too numerous, they should be thinned out and replaced with fruit-bearing trees. The seed, which take 3 or 4 weeks to germinate, are of the size of small peas; about 230 when fresh go to an ounce, or 500 when partly dried. Different names are sometimes employed to distinguish the different forms of the fruit, as "Ceylon," "Madagascar," "West Indian," etc.; these, however, are misleading, for the tree is nowhere indigenous in the Eastern Tropics, and the fruit is variable, as already stated. (See also *Mountain Papaw.*)

Caryocar nuciferum. Butter-nut; Souari-nut. *Caryocaraceae.* A handsome, lofty tree, attaining a height of 80–100 ft., with large, lanceolate, trifoliate leaves, native of Guiana. It bears a large, roundish, woody fruit, about the size of a child's head, containing when ripe 3–5 large, kidney-shaped seeds, which have a very hard, woody, warty and reddish shell. The kernels have a pleasant nutty taste, and are esteemed for confectionery and fruitarian dishes; they contain 60 per cent. of fatty oil.

SOUARI-NUT (*Caryocar nuciferum*). (1) Flower buds; (2) open flower; (3) nuts; (4) nut split open.

Souari-nuts are exported, and may sometimes be seen in Covent Garden Market, London. Their chief drawback may be said to be the extremely hard shell; this is best opened by prising the halves apart along the central suture. The tree flourishes in the moist low-country of Ceylon, and prefers rich, deep loam or alluvial soil. The two trees in Peradeniya and Henaratgoda Gardens, introduced in 1891, grow well but have not yet fruited (1925). The tree in the former garden has flowered freely since 1910, while that in the latter garden flowered in 1922 for the first time.

C. tomentosum. "Piquia." A tree similar to the above, native of Brazil. Said to bear fruit in six years from planting. Fruit edible and rich in fat.

Citrullus vulgaris. Water Melon; Komadu or Peni-komadu, *S.* *Cucurbitaceae.* A smooth, ovoid gourd, usually about 8–10 in. long, sometimes round, produced by a quick-growing, creeping vine, commonly cultivated in the dry region of Ceylon and in warm countries generally. The fruit is dark green, often streaked with white, with a reddish, juicy flesh, which is cool and refreshing though rather insipid. It is reported in India as growing "sometimes 3–4 ft. in length and from 15 to 20 in. in diameter." The smaller-sized varieties are, however, the best. The plant thrives in ordinary soil, provided sufficient moisture is afforded at the root, and is best suited to dry districts. In India it is commonly grown on the banks of rivers, where the natives often bury the fruit under dry sand to ripen slowly. Largely cultivated in warm, temperate countries as a summer fruit. Easily propagated from seed.

Citrus Aurantium, var. (C. sinensis). Sweet Orange; Peni-dodan, *S*; Naran-kai, *T.* *Rutaceae.* A small tree or shrub, 8–12 ft. high, considered to be a native of China or Indo-China. The Orange has long been cultivated in all warm climates, and to greatest perfection in the sub-

tropics, or in regions where the trees are subject to light wintering or a short period of rest. It thrives, however, in the tropics, growing at low and medium elevations in numerous varieties. In the moist low-country of Ceylon, especially when not cultivated with some care, the fruit is often coarse and thick-skinned, being invariably green when ripe. These defects, due doubtless in part to the moist, tropical climate, could to a large extent be eliminated by greater attention to the selection of varieties, by vegetative means of propagation, and by good cultivation. At the higher elevations imported grafted plants flourish for a few years, producing attractive yellow fruits of fair quality, but the excessive rains and strong winds often prove detrimental both to the crop and the tree, the latter being consequently short-lived as a rule. Oranges are extensively cultivated for export in various sub-tropical countries, as S. United States, S. Africa, Australia, Palestine, W. Indies, etc.

Propagation is best by budding upon the more hardy and vigorous-growing kinds of Citrus, as Sour-orange, Pomelo and Lemon. Only budded or grafted plants can be relied upon to produce fruits of a uniform type and quality. The flowers being naturally subject to cross-fertilisation, plants raised from seed are obviously liable to produce fruits of a variable character. Seedling trees are, however, usually the healthiest and longest-lived and, provided due care is exercised in their selection, may yield good fruit, suitable at any rate for home consumption. In propagating from seed, care should be taken to choose the best fruits, selecting from these only full and plump seeds. Sow the latter in well-prepared soil, covering them with about ½ inch of finely sifted earth. The seeds, if fresh, germinate in about 3 weeks. When the seedlings are 2 or 3 in. high, transplant them into small plant-baskets or bamboo pots. These should be ready for planting out or, if desired, for budding or grafting on, in 10 or 12 months; budded or grafted plants should be fit for planting out when about 18 months old.

Cultivation. The nearest approach to the best conditions for orange culture in Ceylon would appear to be found in the drier parts of the Uva Province, between 3,000 and 4,000 ft. elevation. The tree is especially suited to a gentle slope with free natural drainage, rich soil on a marly or limestone formation, a rather dry climate (with intermittent irrigation), and requires shelter from strong winds. A strong sea-breeze is injurious to the crop. In India a resting period is imitated annually by withholding water from the trees, removing much of the soil from around the roots and exposing these. This has the effect of making the trees drop the greater part of their leaves, thereby imitating the effect of wintering. When the roots have thus been exposed for about a month or 6 weeks, the soil is again filled in with a liberal application of manure. In dry regions, oranges do well under irrigation. The tree suffers from no serious pest in Ceylon. (See *Insect Pests.*)

Planting and Yield. Spacing may be 15 × 15 ft. in indifferent soil (say 193 trees to the acre), to 25 × 20 ft. or about 88 trees to the acre in rich soil. The trees should commence to bear when about 4 years old, and are considered to be in their prime at the age of 10 or 12 years. When in full bearing, good trees should average 400 to 600 fruits a year, but much heavier crops have been recorded.

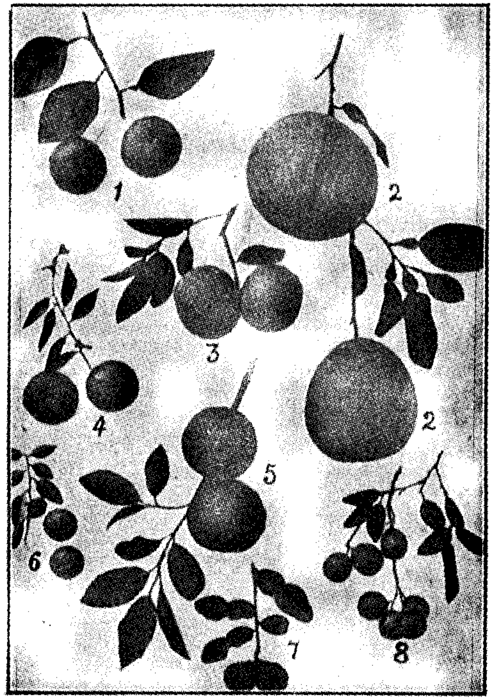
Manuring and Mulching. The chief requirements of the orange tree may be said to be potash and phosphoric acid. A successful grower in Australia applies 2½ lb. each of bone-dust and phosphate of lime per tree once a year, while in Florida burnt shell-lime is often applied at the rate of ½ ton to the acre. The ground around the tree should be frequently forked lightly on the surface, and never allowed to harden. Mulching is of special benefit, and a dressing of any well-decomposed organic manure may be given annually. Good natural drainage is essential, as otherwise the roots become affected and the trees cease to be productive.

Pruning. Good orange trees require but little pruning, beyond the removal of superfluous, dead or damaged branches. The young plants should be topped at a height of about 3 ft., so as to induce a spreading bushy form. The fruits, it should be remembered, are borne on 1-year-old wood. Excessive woodiness may sometimes have to be checked by cutting the tap-root below 15 in. from the surface, or by applying the resting method above described. (See *Root Pruning.*)

Packing and Export. For export purposes, the fruits are carefully washed,

sorted, and individually wrapped in soft tissue-paper, then packed carefully in crates of regulation sizes, each containing a definite number of fruit. Different countries have their own standard sizes of cases. In Jamaica, which has in recent years developed an export industry in oranges, the standard size is 2 ft. in length, 1 ft. in breadth, and 1 ft. deep.

By-products are obtained from different species or varieties of Citrus, as *candied peel* (from the rind), *citric, lactic,* and *acetic acids* (from the fruit juice), *essential oil* (from the peel), the perfume *bergamot* (from the flowers as well as rind), and orange wine, etc., are made from the pulp. Marmalade is made chiefly from the sour varieties, especially the "Seville orange," see below.



Citrus Fruits in Ceylon.
(1) Sweet-orange; (2) Pomelo; (3) Grape-fruit; (4) Mandarin-orange (Jamanaran); (5) Wild orange (*Citrus medica var.*) or "Patharan" (used only in medicine); (6) Tangerine or Nas-naran; (7) Kaffir-lime or "Kudala-dehi" (used only in medicine); (8) Limes.

Varieties. The following are well known:—

Baqubah. Medium size, juicy and sweet. Well known in Iraq.
Jaffa. A large, ovoid, seedless fruit of first-rate quality; pulp rich and juicy; thick- but loose-skinned. Much grown in Palestine.
Jama-naran, S. See *Mandarin.*
King Orange. A fine, large variety of the *Mandarin* type.
Kumquat. A small Japanese loose-skinned variety, commonly used for pickling in Japan and China.
Maltese Blood-Orange. Medium-size, flesh deep crimson; seeds few; tree spineless.
Mandarin. Jama-naran, *S.* (*Citrus nobilis*). Large, loose-skinned; segments easily separated; usually compressed at both ends; seeds small, few. Largely grown in India, Florida, etc. There are many varieties of this type, said to have originated in Indo-China.
Nagpur Suntra. An Indian orange of the *Mandarin* type, famous for its sweetness.
Satsuma (= *Unchus* of Japan). Large fruits, of the *Mandarin* type, produced in large bunches; almost seedless.
Seville Orange. Citrus Bigaradia, = *C. vulgaris.* Large, juicy, bitter fruit, bright orange-yellow. The tree thrives and bears freely in up-country gardens, Ceylon, where its large well-coloured fruits make it a striking object when in full crop. Bears two crops a year, and the fruits make the finest marmalade. (See *Up-country Fruits.*)
St. Michael. Large, thin-skinned, blood-red, fine flavour.
Suntara. Mandarin type; large, loose-skinned, commonly grown in S. India.
Tangerine. A variety of *Citrus nobilis,* with small or medium-sized fruit; has a distinct aromatic flavour. Known in Ceylon as "Nas-naran."
Valencia. A "late" variety, with a long fruiting season.
Washington Navel. Fruit large, with a navel-like mark at apex; very juicy, almost or quite seedless; tree almost thornless, bears fruit early. Considered one of the finest of all oranges.

C. acida (*C. aurantifolia*). Lime; Dehi, *S*; Dhaisi-kai, *T.* A small spiny tree of Trop. Asia, cultivated in all warm countries for its acid, juicy fruit, which takes the place of the lemon in the tropics. The fruit varies in size, acidity, juiciness, oil content, etc., also in shape from almost round to ovoid. It is used by all races for flavouring and general culinary purposes, is largely employed for making lime-juice cordial and other cooling drinks, and enters much into native medicine. Applied externally, it is sometimes considered a cure for snake-bite.

Limes are grown as a commercial product in some W. Indian islands, more especially Montserrat and Dominica, where the preparation and export of raw or concentrated lime-juice, etc., forms an important industry. Lime oil is obtained as a by-product in the preparation of this product, also a valuable essential oil by expression from the rind, used in perfumery, etc. In Ceylon, limes are in season practically all the year round, except perhaps during prolonged periods of dry weather, and are sold in every boutique and market. The tree thrives up to 3,500 ft., preferring a rich friable soil with good natural drainage. It is propagated by seed (pips), or preferably by budding on stocks of a strong growing kind, or on the Sour-orange, Pomelo or Shaddock (*Citrus decumana*).

Spacing and Yield. The plants may be spaced about 15 × 12 ft. on indifferent land, up to about 20 × 20 ft. on rich soil. They begin to bear in the third or fourth year from planting. When in full bearing, 125 barrels of fruits per acre a year is a fair average yield, though it may be as much as 180 barrels, or 300 lb. of fruit per tree. A barrel (about 160 lb.) of ripe limes yields 7½–8 gallons of concentrated lime juice, which produces an average of 12–14 oz. of citric acid per gallon. The same quantity of limes yields from 3½–4 oz. of hand-pressed, or 4–5 oz. of distilled oil, a gallon of which weighs about 9 lb.

Varieties. Among the principal varieties recognised in India are: *Patee,* a small round fruit, much esteemed; *Kaghuzee,* of the size of a hen's egg, in most general cultivation; *Gora,* a small ovoid fruit, much cultivated; *Kamuralee,* a large fruit, of pale lemon colour, "sometimes the size of a small coconut"; *Rungpore,* a round, smooth-skinned fruit; *Taba,* a large globose, spongy fruit. The *Kaffir Lime* (*C. hystrix*) in Ceylon is about the size of a lemon, with a warty coarse skin, and is used only in medicine. *Spineless Lime,* a "sport" said to have first originated in Dominica in 1891; fruit rich in citric acid. *Seedless Lime;* several varieties are almost, if not quite, free from seed. The *Persian Seedless* (= *Tahiti Lime*) is the chief variety grown in Cuba; it is a prolific bearer, and contains a high percentage of citric acid. *West Indian Lime.* A medium-sized, spreading tree; bears heavy crops of pale yellow, smooth round fruits of the size of small oranges, which are juicy, sweet-acid, and make a pleasant refreshing drink. It is similar to, if not identical with, the *Sweet Lime* (*q.v.*).

C. Limetta. Sweet Lime. A distinct fruit of the form of a moderate-sized orange, with smooth pale-green rind. It has a sweet-acid taste, and makes an agreeable and refreshing drink. The tree is used largely in parts of India for budding the Orange.

Citrus grandis (= *C. decumana,* var.). Grape-fruit, said to be so-called from the fruit being produced in clusters, like grapes. These resemble large oranges or small pomeloes, being usually globular, but sometimes ovoid, with a smooth skin of medium thickness. The pulp is pale yellow, greenish-white or pink, with a bitter taste, and is composed of large and distinct sacs; it varies in degree of juiciness and acidity according to variety.

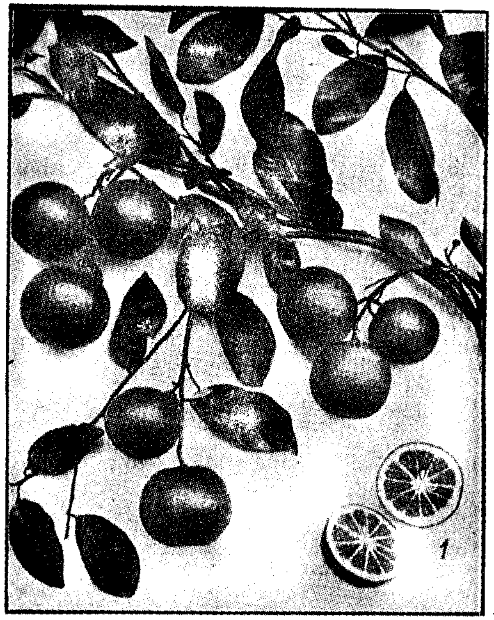
Though long known in a semi-wild state, it has only comparatively recently come into favour and is now cultivated commercially in the W. Indies, California, S. Africa, etc. It is especially popular in the U. States as an early morning fruit, being also made into a popular beverage or "Grape-fruit Cider." It is largely imported into Europe and esteemed by many, finding a ready sale at 3*d.* to 5*d.* each. According to the *British Medical Journal,* it has "the physiological action of stimulating the appetite and promoting salivary and gastric digestion." The Grape-fruit is now becoming well-known in the East and is often met with in gardens. It thrives

at medium elevations, but is best suited to sub-tropical conditions. Its cultural requirements are similar to those of the Orange.

Propagation is best by budding. In the W. Indies, however, it is considered to come reasonably true from selected seed, but some of the best varieties are seedless or almost so. The following are among the best: Marsh's Seedless, Conner's Prolific, Triumph, Pernambuco, Royal, Ellen, and Walters.

C. Limonum. Lemon; and **C. medica.** Citron. (See *Sub-tropical Fruits.*)

Tangelos. A cross of recent introduction, between the Tangerine Orange and Grape-fruit, has been given the name of Tangelos. The fruit is of the size of a medium orange or small grape-fruit, orange-yellow, smooth-skinned, "with a characteristic flavour," and is grown commercially in Florida. There are several varieties, as Sampson, Thornton, Seminole, etc. It is, however, scarcely known as yet in Covent Garden Market, London.



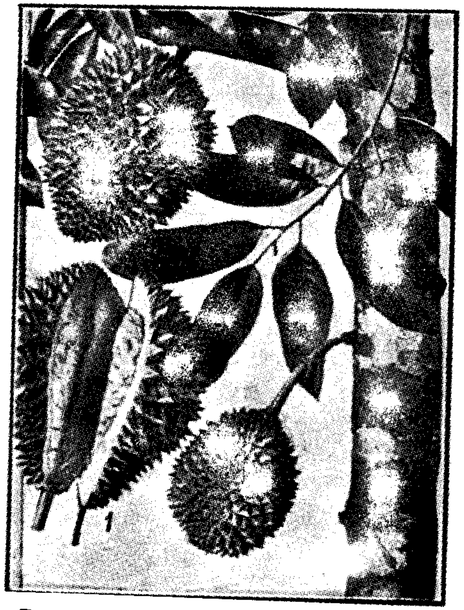
GRAPE-FRUIT (*Citrus grandis*).

Cucumis Melo. Musk Melon; Cantaloupe; Pitti-kekiri, *S. Cucurbitaceae.* A round or ovoid fruit, about 4–5 in. in diameter, with netted or smooth skin, red or greenish-white flesh, produced by a creeping annual gourd with large angular leaves. The fruit has a strong pleasant odour, the interior being of a somewhat floury consistency. The best varieties, as grown in hot-houses in temperate countries, are highly prized on account of their luscious flavour. The plant is suited to a hot, dry climate and rich porous soil. It requires moisture at the root, but the vines are susceptible to a damp atmosphere, and in cultivation the precaution has usually to be taken of forming a collar of earth round the base of the stem to keep the latter dry.

Varieties. There are many varieties in cultivation. A fine variety in India called the "Surdah," the fruit of which has large seeds and is "sometimes brought from Cabul to Punjab for the wealthy classes, who are said to pay a high price for them." An inferior variety is sometimes cultivated in the dry region of Ceylon. Propagation is by seed, like most other gourds.

Durio zibethinus. Durian; Civet Fruit. *Bombaceae.* A very large, stately, upright tree, indigenous to Malaya, but now seldom found in a wild state; commonly cultivated in the Straits, Burma, Java, etc., for the sake of its celebrated fruit. The latter, produced on strong, mature branches, varies somewhat in shape from round to ovoid, is yellow when ripe and usually weighs from 6 to 8 lb., sometimes as much as 10 lb. or more. It is armed with thickly set, sharp-pointed spikes about ½ in. long, and possesses when mature a very offensive odour, more especially so on first acquaintance. The white custard-like pulp surrounding the

seed is highly relished and regarded as an aphrodisiac by Malays and others; it is also esteemed by some Europeans who acquire a taste for it once the smell is overcome. It has been described as "resembling blanc-mange, delicious as the finest cream," whilst according to Russel Wallace "the sensation of eating durians is worth a voyage to the East." Others, however, have compared it to "French custard passed through a gas-pipe." The Malays preserve the fruit in salt for use all the year round. The large seeds may be roasted and eaten like chestnuts.



DURIAN FRUIT (*Durio zibethinus*).
(1) Fruit split open showing white edible suet-like pulp surrounding seeds.

The tree thrives in the moist low-country of Ceylon up to 2,000 ft., and luxuriates in deep, alluvial or loamy soil. In Peradeniya Gardens there are magnificent specimens about 100 ft. or more in height. They usually flower here in March or April, and the fruit is ripe in July or August, but sometimes the flowering and fruiting periods change with an abnormal season. The fruits vary to some extent in size, shape, flavour and quality of pulp, according to variety, whilst the trees also vary in productiveness, some being almost barren, especially as they get old. The best varieties should, therefore, be selected for propagation. The tree is readily propagated by seed, which should be sown fresh. The large, fleshy seed is of short vitality, and germinates in about 8 days.

Garcinia Mangostana. Mangosteen; Mangus, *S*; Mangus-kai, *T. Guttiferae.* A small or moderate-sized conical tree, with large, leathery leaves, native of Malaya, introduced to Ceylon about 1800. Its globular, purplish-brown, smooth fruit, about the size of an apple, is famed as one of the most delicious fruits

MANGOSTEEN (*Garcinia Mangostana*).
Showing fruit whole, also cut open to show the snow-white pulp.

of the tropics, and considered by some to "partake of the flavour of the strawberry and the grape." The delicate snow-white, melting, juicy pulp surrounding and adhering to the seed is the part eaten. In striking contrast to this is the dense, thick, reddish-purple rind, which contains tannic acid and a dye.

The fruit is in season in the low-country of Ceylon from May to July, and at higher elevations from July to August, or September to October. It is usually sold in the markets at about 1*s.* to 1*s.* 6*d.* per dozen. The tree is of slow growth and does not generally come into bearing till 9 or 10 years old, but takes several more years to attain full size. The essential conditions are a hot, moist climate; deep, rich, and well-drained soil, and a sheltered locality. Light shade is beneficial; in the young state it is essential. The tree responds to manuring, and thrives up to about 2,000 ft. in the moist region. Propagation is usually by seed, but may with some difficulty be effected also by "gootee" or layering. Sow seeds in pots or boxes under cover. The plants are of very slow growth, taking two years or more to become large enough for planting out, being then only about 12 in. high.

SAPUCAIA NUT (*Lecythis Zabucajo*). Showing oblong wrinkled nuts and large lid by side of enormous woody shell.

Lecythis Zabucajo. Sapucaia-nut; Monkey-pot. *Lecythideae.* A large forest tree of Brazil and Guiana, closely allied, but superior, to the Brazil-nut. The oblong, wrinkled nuts (seeds), about 2 in. long, enclosed in a very large, brown, woody shell, are of a delicate flavour and considered by some to be the finest nut known. As distinct from the Brazil-nut, the shell is furnished with a large lid, which when ripe becomes detached and allows the seeds to drop out. Owing, therefore, to the difficulty of collecting these, they are more rare and command a higher price than the Brazil-nuts. The empty shell, deprived of the lid and baited with sugar, etc., is used as a trap for catching monkeys, the latter being unable to withdraw their heads when inserted. Dogs also have been trapped in this way. Introduced to Ceylon in 1897, but not yet fruited there. The "nuts" are used in chocolates and other forms of confectionery.

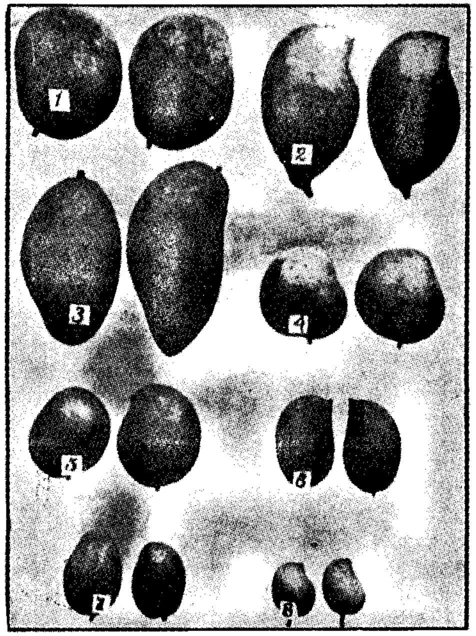
Mangifera indica. Mango; Amba, *S*; Manga, *T*. *Anacardiaceae.* A medium or large-sized, spreading and quick-growing tree, indigenous to Trop. Asia. It bears large panicles of greenish-white, scented flowers, usually in January–March, followed about 2½–3 months later by the fruit. A second crop is sometimes obtained in August–September. The round, oblong, or ovoid fruit is somewhat flattened, generally with a more or less pronounced beak near the apex. It may weigh from 6 oz. to 1½ lb. or more; has a rather tough, thin skin and, when ripe, is yellow, reddish, or green. The flesh is usually of a reddish tint, with a distinct,

pleasant, aromatic flavour; less superior varieties have a turpentiney flavour and a somewhat resinous and fibrous flesh. In the centre is the large fibrous, ovoid, flat seed. The mango is the fruit *par excellence* of India, where it has been grown from early times. The tree is cultivated in all warm countries, and the fruit is used largely in chutneys, jam, preserves, etc.

Cultivation. The tree thrives from sea-level to about 3,000 ft. or higher. A rather dry climate, with a hot season, and a rich, deep, well-drained soil suit it best. The ground should be irrigated during prolonged drought, especially when the trees are setting fruit, also manured once a year, and mulched in dry weather. Pruning consists in thinning out superfluous or weakly branches; root-pruning is sometimes applied with advantage to trees which become unfruitful owing to their running too much into wood and leaf, the operation being performed by digging a deep trench round the tree at a few feet from the stem, cutting all roots met with. See *Root Pruning.*

Propagation is best by grafting (*inarching*) on seedling stocks of a vigorous variety. The "gootee" method of layering is commonly adopted in India (see *Grafting*). Bud-grafting (plak-budding) may also be successfully effected.

Plants are easily raised from seeds, and if care be exercised in selecting the best fruits from good varieties, these may become good fruiting trees. The seed is often polyembryonic (see *Seeds*), each producing from 2 to 6 plants or more, which, owing to their asexual origin, are practically equivalent to budded plants. Frequently, however, seedling trees are liable to be disappointing, both in productiveness and quality of the fruit, and take longer to come into bearing than those from layered or grafted plants, which should commence to bear in their fourth year. Before planting out, large holes, not less than 3 ft. wide by 3 ft. deep, should be dug, mixing well-rotted manure with the soil when filling in. Spacing should be not less than 28 or 30 ft. each way; in rich soil it may be 32 × 32 ft. or more, thus allowing more space for inter-crops.



TYPES OF MANGOES IN CEYLON.
(1) "Rupee"; (2) "Jaffna"; (3) "Alphonso"; (4) "Baiti" or "Bombay"; (5) Mee-amba; (6) Gira or "Parrot"; (7) "Cotta-amba"; (8) "Et-amba."

Varieties. Numerous varieties are in cultivation, the fruit varying in shape, size, flavour, juiciness, succulency, etc. Certain small-fruited varieties are almost seedless (see below). Varietal names are numerous, and often different names are given to the same varieties in the same or different countries. In Ceylon, there commonly occur the following distinct types, and of these there are many sub-varieties.

Rupee or *pol-amba.* Fruit very large, roundish and rather flat; pulp luscious and free from fibre; similar to *Cowasje Patel* or *Inerma* of India.

Jaffna. Large, ovoid fruits, of excellent quality when well-grown; similar to *Alphonso.*

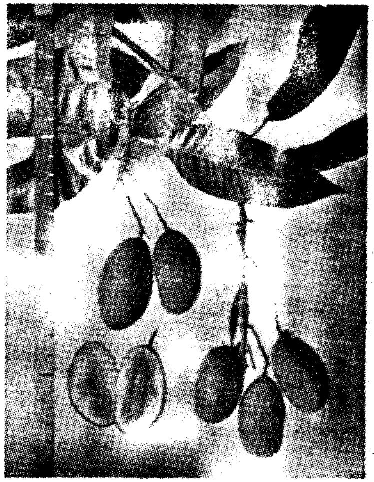
Parrot-mango (*Gira-amba*). Medium-sized, oblong fruit, with a distinct beak, piquant and pleasant flavour.

Bombay or *Baiti-amba.* Round and rather flat, very juicy, yellow when ripe.

Dhampara. Fruit rather small, very sweet.
Honey-mango (*Mi-amba, S*). Small, roundish fruit of a sweet flavour.
Maha-mudaliyar (*Puhu-amba*). Very small, seedless fruit, with sweet, juicy pulp; distinct piquant flavour.

The following are a few, out of a large number, of the principal Indian Mangoes:

Alphonso. Fruit large, ovoid, about 6 to 8 in. × 3½ in.; pulp of the finest piquant and delicate flavour. Considered one of the best.
Banchore or *Dhairey.* Yellow fruit, 3 in. × 2½ in., very sweet.
Bangalora. A favourite variety of S. India.
Borsha. Oblong, bright green, with yellow spots when ripe: up to 10 oz., delicious.
Custodio. Very large, yellowish-green, free from fibre.
Mulgoa. Fairly large, yellow and green blotched, no fibre, piquant flavour.
Pairi. Broadly ovoid, with a marked beak; one of the best.
Pakria. Medium-sized, rich crimson, pulp deep yellow.



ALPHONSO MANGO.
One of the best.

Roos. One of the best of the round or "Bombay" type.
Ryotya. Bright crimson, extra fine flavour, practically fibreless.
Salgadina. Medium-sized, rich crimson, flesh deep yellow.
Totapari. Medium-sized, slightly fibrous, excellent flavour.

Well-known mangoes in other countries are:

Philippines: *Caraboa*, bright yellow; *Pico*, next to latter in quality; *Pahutan*, highly flavoured, vigorous grower. Cuba: *Biscochuelo*, one of the best varieties known. W. Indies: *Julie, Peters, Minnie, Martin, Pere Louis.* Florida: *Sundersha*, large clear yellow, distinct beak, juicy and free from fibre. Mauritius: *Fijette, Baissac.* S. Africa: *Gundoo* (= *Fijette*), excellent variety, grown for local markets and export.

BANANA OR PLANTAIN (*Musa sapientum*). (1) stem; (2) bud end of flower stalk, used as a vegetable; (3) and (4) a single flower; (5) comb of fruit; (6) section of unripe fruit; (7) mature "finger."

Musa sapientum. Banana or Plantain; Kehel, *S*; Vala, *T*. *Scitamineae*; Ginger family. A small, quick-growing, noble tree, 10–15 ft. high, with a herbaceous stem composed of the sheathing leaf-stalks, the large, handsome, oblong, entire blades being 12–15 ft. long.

For productiveness combined with grandeur, this is without a rival in the vegetable kingdom. At the age of about 12–15 months, the drooping flower-spike, 3–5 ft. long, emerges from the centre of the crown, bearing unisexual flowers in clusters, "females" first and "males" towards the end. The ovaries of the former rapidly grow into large finger-like fruits, in clusters ("combs"), underneath large succulent and coloured bracts. The banana requires a hot, moist climate, and the fruit is in season all the year round. It is a nutritious and easily digested food, and is to the inhabitants of the torrid zone what the potato is to those of the temperate zones. It is the most prolific of all food-crops, producing, as calculated by Humboldt, 4,000 lb. in a space required to produce 33 lb. of wheat and 98 lb. of potatoes. According to *The Lancet*, the starch of the banana is more digestible than the cereal starches. It may be dried and made into flour, which is sometimes valued as food for invalids; mixed with wheat flour, it may be made into biscuits or porridge.

Cultivation. The tree thrives in deep, fairly heavy and moist soil. It is essentially suited to a hot and humid climate, and will thrive up to about 4,000 ft. in sheltered valleys. A windy situation and a rocky or sandy calcareous soil are unsuited to it. *Propagation* is by suckers or shoots which rise from the rootstock. These may be planted out direct at distances of about 12 × 12 ft. (say 300 to the acre), in large deep holes filled with good soil and manure. Fertile seed is rarely produced by cultivated varieties, but wild or neglected plants do sometimes produce seed. The plant throws up several shoots from the base, forming a clump; these should not be allowed to exceed about half a dozen stems. The clumps should from time to time be moulded up with surface soil and any mulch of dead leaves, etc., available. The plant is a gross feeder and responds well to manuring and deep tillage. Farmyard manure is best, but a mixture comprising sulphate of potash, sulphate of ammonia and superphosphate, in the proportion of 2, 2, 4 respectively, is recommended. All leaves and trash should be returned to the soil in the form of mulch placed around the plants and covered with earth. Stems which have fruited should be cut down to about a foot from the ground, and either used as mulch or thrown on a heap for manure.

Yield. The first bunches of fruit may be obtained about a year after planting, each stem fruiting only once, after which it dies down and others grow up around it, the clump thus continuing productive for several years. The bunches should be picked about a week before the fruit is ripe, especially if transport is considerable, as ripe fruit is naturally more susceptible to injury. Under good tillage an acre is considered to produce about 300–400 or more marketable bunches annually. A standard bunch contains from 9 to 12 "hands" or "combs," each "hand" 12–16 or more "fingers," and an average bunch from 150 to 200 "fingers." A bunch may weigh from 50–80 lb. or more. See *Musa Cavendishii*.

Varieties. In the W. Indies the term *Plantain* is applied only to sorts eaten cooked, being generally distinguished from the Banana by their larger and horn-shaped fruits; these are supposed to have been derived from *Musa paradisiaca*, and the Banana from *M. sapientum*. In the Eastern Tropics, however, this distinction is not generally recognised, both "cooking" and "table" sorts being commonly known as Plantains. A great number of varieties occur in cultivation. Of those grown in Ceylon the two best are *Suwandel* and *Koli-kuttu*, the latter resembling the *Gros Michel* of the W. Indies. Less superior varieties are, however, the most cultivated, probably because the most prolific and hardiest, such as *Embul-hondarawala*, *Anamalu*, and *Rath-kehel*, or forms of these.

The following are the principal varieties met with in Ceylon:

Anamalu, fingers stout, rather angular, sub-acid, large bunches; *Bin-kehel* or *Dwarf plantain*, similar to *Anamalu*, fingers thickly set, smooth yellow skin; *Embul-hondarawala* or *Sour plantain*, most common kind met with in markets and bazaars, fingers straight, fragrant, sub-acid; *Koli-kuttu*, fingers large and stout, loose-skinned, sweet, mealy, produced in large bunches; *Puwalu*, fingers thin and rather angular, somewhat acid; *Ranel* or *Red-plantain*, large red fingers, borne in huge clusters,

coarse, thick-skinned, mealy, chiefly grown in the north of Ceylon, taking 15 months or longer to come into bearing, as against 12 months for most other kinds; *Rata-hondarawala*, thickly set combs, angular, stout fingers, rather sweet; *Rath-kehel*, short, smooth, round fingers, rather acid but pleasant; *Suwandel*, thin-skinned, usually short fingers, tender and sweet, considered the best in Ceylon; not commonly grown for market.

While almost all the above may be cooked in an unripe state and eaten as a vegetable, the following are used chiefly for that purpose only:

Alu-kehel or *Ash Plantain*, slender stems, stout and angular fingers, covered with a greyish bloom; *Kochi-kehel*, large, stout, brownish-red fruit; *Marthamalu*, short, stout, thick fingers, resembling *Anamalu* in taste; *Nawari* or *Wanduru-anamalu* (Monkey-banana), long, thin, greenish-yellow fingers; dark slender stems; *Puspakadali*, short, stout fingers, thin-skinned; *Suramondan*, large, green, angular fruit, borne in huge clusters.

Gros Michel (= *Martinique*), a tall robust variety, said to have been introduced to Jamaica about 1836, is the principal variety grown in the W. Indies for export. It is a heavy yielder, with large fruits of good flavour, and bears transport well. Similar in habit to this are the *Giant Fig* of Grenada and *Lacatan*, both considered to be reasonably immune from the "Panama disease" (*q.v.*).

M. Cavendishii. Dwarf or Chinese Banana; Nan-kehel, *S.* Native of S. China, largely cultivated in the Canary Islands, etc., for export; also in the W. Indies, Brazil, Pacific Islands, Mauritius, Ceylon, etc. It is distinguished by its short, stout stem (4–6 ft. high), short, thin-skinned and sweet fruit, which, being more delicate than the above, requires more careful handling in transport. The plants may be spaced 9 × 9 ft., withstand a higher elevation than the foregoing, and may yield 900 bunches per acre. The bunches often contain 220 fingers or more.

Diseases. The Banana has in recent years become subject to two distinct virus diseases, viz. the "Panama disease," which was first observed in Panama, and the "Bunchy-top" disease. Only the former is known in Trop. America and the W. Indies, but both occur in Asia, and the latter also in Egypt, the Canary Is., and parts of W. Africa. Efforts are being made, with promising results, in Trinidad and elsewhere to obtain immune varieties by hybridising and crossing. See *Fungus Diseases.*

M. Ensete. Abyssinian Banana, or Ensete. A stout, single-stemmed, handsome species, the largest of the family, but does not bear an edible fruit. It grows to a height of 20 to 25 ft., with a crown of enormous leaves 10–15 ft. long by about 1½ to 2½ ft. broad. The fruit is "dry," 3–4 in. long, with a few large black seeds.

Nephelium lappaceum. Rambutan; Ramtum, *S.* *Sapindaceae.* A large, handsome, spreading tree, with pinnate leaves, native of Malaya, producing (chiefly in July–August) large clusters of bright red or orange-yellow fruits, suspended from the ends of the branches. Each fruit is of the form of a large gooseberry, covered with long, soft, coloured, fleshy spines and containing a large seed surrounded by a layer of white, melting pulp (aril), which has an acidulous agreeable taste. Birds and bats are, unfortunately, particularly partial to it. Though common in the low-country of Ceylon, Malaya, etc. the tree appears to be little known in India, Mauritius, Madagascar, etc. It is readily propagated from seed, but the best varieties should be raised by layers or gootees. Thrives up to 2,000 ft. elevation.

N. chryseum (N. mutabile). Pulassan. A Malayan tree, similar to the Rambutan in appearance. It differs from it, however, in that the leaves are grey beneath, the fruit being larger, purplish-brown, with short blunt processes. According to Ridley, the flavour is decidedly superior to that of the Rambutan. Not yet become well known in Ceylon.

N. Litchi. Litchi or Litchee. A medium-sized tree, with glossy, pinnate leaves, native of China. It blossoms usually in the dry season, producing sprays of pale-green flowers, and ripens fruit at Peradeniya, Ceylon, from August–September. The fruit, borne in large clusters, is of the size and form of a plum, with a rough, thin, warty rind, which on ripening assumes a pinkish-crimson tint, turning to a dull brown colour. The jelly-like aril which covers the seed is of a translucent whiteness and of an agreeable sweet-acid flavour. (See below.)

The Litchi is grown to perfection in Mauritius and parts of India, the fruit being commonly sold in the bazaars when in season. It thrives up to 3,000 ft. in S. India, giving two crops a year, in May and December. In Ceylon, however, it is rarely met with, though introduced as early as 1802. Several varieties are in cultivation, these being distinguished by size, shape, and quality of fruit.

Passiflora edulis. Passion-fruit. (See *Sub-tropical Fruits.*)

Persea gratissima. Avocado- or Alligator-pear; Aguacate; Soldier's Butter; Et-pera, *S*; Anakoya-pallam, *T.* *Lauraceae.* A small tree, 25–30 ft. high, native of Trop. America, producing a large, usually pear-shaped fruit, which is much relished by some people but not by others. It contains in its hollow centre a large, round, fleshy seed, between which and the thin skin is a thick layer of greenish-yellow pulp, of the consistency of firm butter and somewhat suggesting walnut in flavour; this may be scooped out with a spoon and eaten either plain or flavoured with salt, pepper and vinegar, though some prefer it with sherry, etc. The green, tender skin assumes a yellowish tint (pinkish crimson in some varieties) on ripening. It should be picked before it is quite ripe, and kept for a few days to become slightly soft.

Litchi Fruit (*Nephelium Litchi*). Fruit pinkish crimson.   Rambutan (*Nephelium lappaceum*). Fruit orange-red or yellow.

The tree is commonly grown in the Eastern tropics, as well as in Florida, Mexico, Queensland, Madeira, Natal, etc. The fruit is very popular in the S. United States, and is sometimes imported into London from the Canary Islands. It is very susceptible to injury by bruising, and therefore rather difficult of transport. The tree thrives best at medium elevations or under sub-tropical conditions, bearing fruit abundantly, chiefly in July–August in Ceylon. There are several more or less distinct varieties, the fruit varying in shape, size (5–7 in. long by 3–4 in. in diam.), colour, thickness of flesh, etc. A good tree will bear from 400 to 600 or more fruits a year, and each fruit may weigh from about 1 lb. to nearly 2 lb. Propagated by layering or grafting on young stock, or from seed, which is of short vitality and should be selected and sown as fresh as possible.

Avocado Pear (*Persea gratissima*).
(1) Fruit in section; (2) seed.

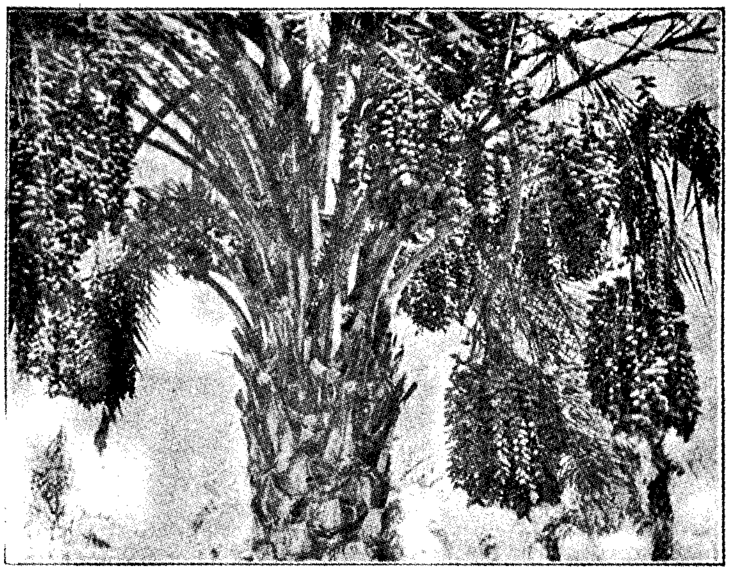
Phoenix dactylifera. Date Palm. *Palmae.* A sub-tropical dioecious palm of great antiquity, attaining a height of 60–80 ft., with handsome, pinnate leaves, extensively cultivated for its fruit (the dates of commerce) in N. Africa, Egypt, Syria, Iraq, Persian Gulf, etc. All parts of the palm, like the Coconut, serve many domestic purposes. Dates are a standard article of food locally, being also used as food for stock. The palm has been successfully established in California, Queensland, N. India, etc., but efforts made to introduce it to Ceylon and other parts of the tropical belt have failed. A specimen in the Botanic Gardens, Peradeniya, is about 75 years old, but has never flowered.

Date Plantation in S. Iraq,
With Berseem (Egyptian Clover) as ground-cover.

Cultivation. The palm is of a relatively hardy nature, thriving where few other plants

will barely exist. Its chief requirements are great heat for a considerable period of the year, a dry atmosphere, deep alluvial clayey soil, and liberal irrigation during its flowering and fruiting seasons. A brackish or saline soil appears to be beneficial rather than injurious. In countries where it is most successfully cultivated, as South Iraq, the temperature for 5 or 6 months of the year is frequently well over 120° F., while for a brief period in the cold or winter months it may be down to or below freezing point; the rainfall, if any, is confined to the latter period, and may be only 3–6 in. or none. Irrigation is essential, usually about once a week, this being reduced or stopped after the fruits begin to ripen, viz. in August or September. No irrigation is necessary in the cold season or until the palms begin to blossom in February or March.

Propagation, etc. The palm, both male and female, is usually propagated by offshoots or suckers, which are produced by the younger palms up to the age of 10 or 12 years. It is seldom raised from seed. Offshoots are not usually separated



Date Palm in Fruit (*Phoenix dactylifera*).

from the parent until 3 or 4 years old. They are then removed and established in nursery beds, or they may be planted at once in their permanent places. Spacing may be about 28 × 28 ft., say 58 to the acre. Large, deep holes are prepared as for Coconuts, these being at first only partially filled, using rich soil and adding some well-decomposed manure, the plants being shaded and kept moist. The best time for planting is the early spring. It is usual to plant one male to about every fifty females for the purpose of pollination, which is effected artificially.

Yield. The palms blossom in March or April, and pollination is effected as soon as the female spathe opens, a sprig of the male blossom being taken and shaken over it and then tied above it. The fruit begins to ripen about 4½ months afterwards. The palms come into bearing about 4 or 5 years after planting, and are in their prime when about 12–15 years old. A good tree will produce 150 lb. or more dates annually, a fair average crop being about 100 lb. each, or 5,000 lb. per acre. The palms may continue productive until they have reached the age of 60–80 years or more, after which they are used for the extraction of toddy (fermented juice), obtained from incisions made in the crown. The toddy, being fermented and distilled, yields an intoxicating spirit, *arrack*. (See *Sugar Palms*.)

Varieties. These are numerous, each Date-producing country having special

varieties peculiar to itself. Among those well-known are: *Fardh* (Arabia), *Deglet Noor* (N. Africa), *Khadrawee, Zahidi, Khalaseh, Hallawee* (Mesopotamia), etc.

Photinia (Eriobotrya) japonica. Loquat; Japanese-medlar. *Rosaceae*, Apple family. A medium-sized evergreen and symmetrical tree, with large, handsome, serrate leaves, which are woolly-white underneath, native of S. China and Japan. It is cultivated in the Riviera and in most warm countries, being suited to medium elevations in the tropics. The small ovoid or pear-shaped, yellow fruits, which are of the size of crab-apples, have a sweetish acid flavour, and may be used for dessert or for stewing, etc. The quality of the fruit, however, varies considerably, according to variety and cultivation. The dingy white flowers are delightfully fragrant. Plants may be raised from seeds, but superior varieties should be propagated by layering or grafting.

Vitis vinifera. Grape Vine. (See *Sub-tropical Fruits.*)

OTHER EDIBLE FRUITS

Exception may be taken to the inclusion of some of the following species as edible fruits, but since the collection without these would be even more incomplete than it necessarily is, it is deemed advisable not to omit them. Certain fruits may be considered edible by some people, and not by others; whilst other kinds may be relished in some countries, but considered inedible in others, *e.g.* "Akee" (*q.v.*).

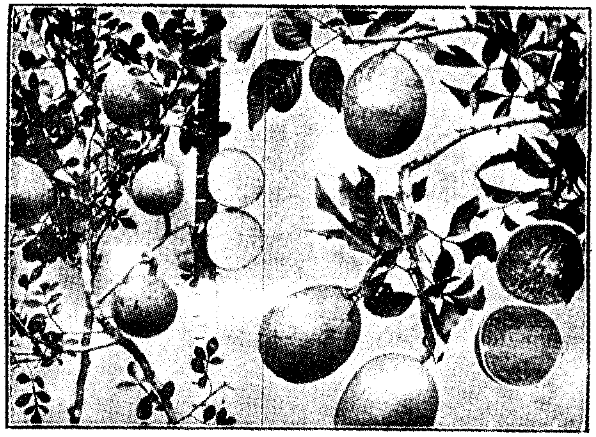
Aberia Gardneri. Ket-embilla, *S* and *T*; Ceylon Gooseberry. *Bixaceae.* A small shrubby tree, peculiar to Ceylon, bearing velvety

CASHEW-NUT (*Anacardium occidentale*). Showing fruit whole and in section.

LOQUAT (*Photinia japonica*).

round berries of the size of large marbles, brownish-purple when ripe. These make good jam or preserve. Worth cultivating, and doubtless capable of improvement by cultivation and selection. Season, August–September. Thrives in sandy loam and requires good drainage. Sow the small seeds in boxes under cover.

Aegle Marmelos. Bael-fruit; Bengal Quince; Baeli, *S*; Vilvam, *T*. *Rutaceae*, Orange family. A small or medium-sized, spiny tree with small trifoliate leaves, native of India, commonly grown in Ceylon and other tropical countries for the fruit, which is globular, with a hard, woody, smooth, green shell, 3–4 in. in diameter. Intermingled with the doughy, aromatic pulp is a limpid glutinous substance, which is esteemed for its well-known medicinal properties. When not fully ripe the fruit is astringent, and is a well-known cure for dysentery, diarrhoea, etc., whilst the ripe fruit has a special tonic and laxative effect. Principal season, March–May, but is available throughout the year. Propagated by seed; thrives in ordinarily good soil. (See *Med. Plants.*)

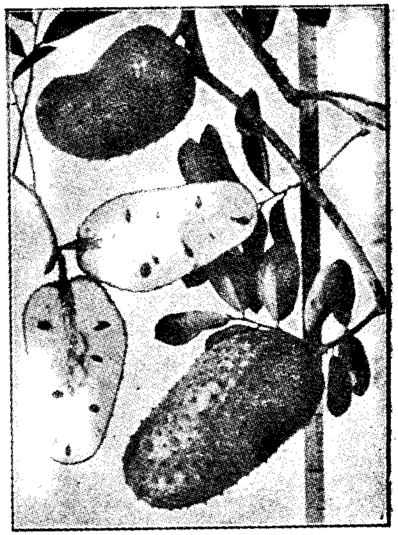


BAEL FRUIT (*Aegle Marmelos*). WOOD APPLE (*Feronia elephantum*). Showing both fruits in section.

Anacardium occidentale. Cashew-nut; Caju-gaha, *S*; Mundiri-maram, *T*. *Anacardiaceae*, Mango family. A spreading tree, 30–40 ft. high, native of Trop. America and W. Indies, naturalised in Africa, Ceylon, India, etc. The fruit consists of two distinct parts: (*a*) the large, fleshy, pear-shaped stalk (Cashew-apple), 3–4 in. long, which is juicy and astringently acid; (*b*) the small kidney-shaped, grey or brown nut, about 1–1½ in. long, at the extremity. The latter has an edible kernel, which when roasted has a very agreeable nutty taste and is much relished for dessert. It is in demand in Europe, and is exported to some extent from S. India, E. Africa, etc. for use in confectionery and dessert. These "nuts" are generally valued in London at about 30–35*s*. per cwt., and in Ceylon are retailed at about 1*s*. 4*d*. per hundred, shelled. The shell of the nut is acrid and poisonous. All parts of the fruit are of various uses in native medicine. An intoxicating beverage (kaju) is obtained by distillation from the fleshy receptacle (hypocarp) in Mozambique, subject to Government licence. A gum obtained from the tree is obnoxious to insects and is recommended for book-binding. The juice from incisions made in the bark forms an indelible ink. The tree is especially adapted to moderately dry districts, near the sea, but also thrives up to 3,000 ft. Propagated by seed.

Anona diversifolia. Ilama; "Anona Blanca." *Anonaceae.* Custard-apple family. A small tree, bearing conical, glaucous, green or pinkish fruit, native of Mexico, where it is commonly cultivated. Climatic and cultural requirements similar to those of the Sugar-apple. The fruit is pleasantly acid-sweet and, according to Popenoe, may be termed "the Cherimoya of the lowlands." Suited to low or medium elevations. Not established in Ceylon.

A. muricata. Soursop; Katu-anoda, *S*; Seetha, *T*. A small, quick-growing shrubby tree, 15–20 ft. high, with fragrant laurel-like leaves, native of the W. Indies and commonly grown in the tropics generally. The large fruit, weighing from 4 to 6 lb. or more, varies in form from kidney-shaped to ovoid, and is covered with soft green prickles. The white and rather woolly pulp, amongst which the large black seeds are scattered, is sweet-acid and juicy, suggesting the flavour of pineapple; it is sometimes used for flavouring ices and in the preparation of a pleasant cooling drink. Prop. from seed or cuttings. Thrives up to 3,000 ft.



Soursop (*Anona muricata*).
Showing fruit whole and in section.

A. reticulata. Sugar-apple; Bullock's Heart; Anoda, *S*; Ramsita, *T*. A small bushy tree of Trop. America and the W. Indies, commonly grown in gardens throughout the tropics. The large heart-shaped or round fruit, brownish-red in colour, contains several large dark-brown seeds interspersed among the sweet custard-like, granular, edible pulp. There is a superstition among some people in Ceylon that the fruit causes leprosy. Thrives at low and medium elevations. This is the Custard-apple of the W. Indies.

A. squamosa. Custard-apple of W. Indies. See p. 229.

Bullock's Heart (*Anona reticulata*).

Artocarpus incisa. Bread-fruit; Rata-del, *S*; Erapillakai, *T*. *Urticaceae*, Fig family. One of the most handsome of tropical trees, native of the Pacific Islands, Java, etc., introduced into Ceylon before 1796. A quick grower, attaining a height of 50–60 ft., with very large, shiny, deeply-cut leaves. The fruit is roundish or ovoid, 5–7 in. long by about 3–4 in. in diameter, pea-green in colour, and produced in twos or threes at the ends of the branches. The best varieties seldom have any seed; seeding varieties contain large fleshy, round, white seeds embedded in the pulp, both seeds and pulp being cooked and eaten.

In the W. Indies a seed-bearing variety is known as the **Bread-nut Tree**, as distinct from the seedless Bread-fruit. The pulp in either case consists of a solid, white, fleshy mass which, when sliced and roasted, is not unlike the crumb of a new loaf. It is esteemed as a vegetable, being used for curries, roasted and ground into flour, or prepared in various other ways. The Bread-fruit forms an important article of diet with the natives of the South Sea Islands. Firminger, after partaking of the fruit in Ceylon, considered it to be "hardly distinguishable from an excellent batter pudding." The tree thrives up to about 2,000 ft. in the moist districts of Ceylon. Its introduction to the W. Indies is associated with the notorious mutiny in 1787 of the "Bounty," while on its way with a cargo of 1,000 Bread-fruit plants from Tahiti. Prop. by root-suckers, gootee, or layering, or from seed when obtainable. (See *Orn. Fol. Trees.*)

Bread-fruit (*Artocarpus incisa*).
Showing fruit whole and in section.

A. integrifolia. Jak-fruit; Kos, *S*; Pilla-kai, *T*. A very large tree, native of S. India and Malaya, commonly cultivated and naturalised in Ceylon. The enormous fruits, some of which may weigh up to 70 lb. or more, are borne on the trunk and older branches, sometimes down to the base of the trunk. Each fruit (botanically a multiple fruit formed of achenes surrounded by fleshy perianths on a common receptacle) is usually oblong and irregular in shape, sometimes almost round, the green rind consisting of fleshy knobs. The fruit forms a very important article of food with the poorer people in the Eastern Tropics, while some of the better classes also relish it, more especially the large, albuminous, white seeds when cooked and served in curries. When ripe, the fruit usually has an overpowering odour, but this does not appear to be considered a drawback. The cream-coloured or yellowish, soft, flaky pulp is eaten either raw, boiled, or fried, and used as a vegetable for curries, etc.

The tree affords an excellent timber, much used for cabinet work, building, etc. in Ceylon; lemon-yellow at first, it turns with age to very dark red, like mahogany, to which it is but little inferior. It is suited to moist or semi-dry districts, up to 2,000 ft. or higher. In planting, the seed should be sown *in situ*, or first in baskets

Jak Fruit (*Artocarpus integrifolia*).
Showing fruit whole and in section.

Wild Bread-fruit (*Artocarpus nobilis*). Showing fruit whole and in section.

or bamboo-pots; seedlings from nursery beds will not bear transplanting well. Large holes should be dug and filled with rich soil; sow three seeds in the centre, and remove the weaker seedlings afterwards, leaving the strongest one.

Varieties. Jak-fruit occurs in several varieties, the two most distinct in Ceylon being "Waraka," distinguished by a firm fruit which is recognised by the sound when flicked with the fingers, and "Vela," characterised by its softer pulp, through which the finger may be thrust when approaching ripeness, the pulp being less sweet than that of the former variety. "Kuru-waraka" has small and almost round fruit, and "Peni-waraka" (honey-jak) has a distinct sweetish pulp.

A. Lakoocha. Kana-gona, *S*; Tampang-manis (Malaya). A large deciduous tree of India, Ceylon, Malaya, etc.; leaves oblong, 8–12 in. long; shoots tomentose. The flat, broad seeds are edible.

A. nobilis. Wild Bread-fruit; Bedi- or Wal-del, *S*; Asini-pillakai, *T*. A handsome tree, usually attaining a height of 60–70 ft. or more, sometimes with a very large trunk, characterised by large leathery, crinkled or wavy, entire leaves, peculiar to the moist low-country of Ceylon. The fruit is cone-like, 6–8 in. long by 1½–2 in. in diameter; it is similar in texture, though inferior, to the Bread-fruit proper, and is eaten by the poorer classes, being cooked and used as a vegetable with curries. It contains several round, white seeds, of the form of large peas, which are roasted and eaten. The tree thrives in a wild state up to about 2,000 ft. in Ceylon, where it is endemic. (See *Orn. Fol. Trees.*)

A. odoratissima. Sometimes known as Johore Jak. The leaves are hairy or pubescent, and the oblong or ovoid fruit, much smaller than the Jak, has a powerful odour. The pulp is sweet and esteemed by those who eat the fruit.

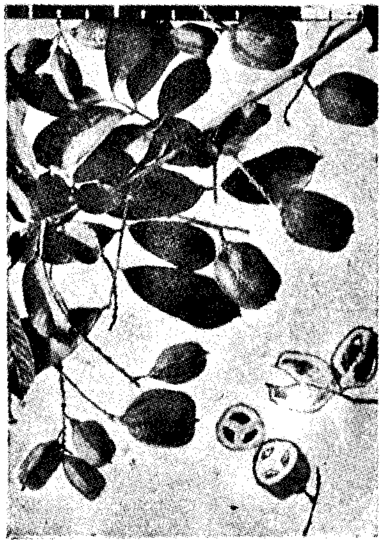
Rambeh or Rambai (*Baccaurea motleyana*).

Carambola (*Averrhoa Carambola*). (A) Cross section of fruit.

A. rigida. Tampumunei, or Buah-perian (Malaya). A medium-sized tree, native of Malaya, with small oval leaves, producing a round or ovoid fruit, about 4–6 in. or more in diameter, furnished with prominent sharp spikes, yellow when ripe. The orange-yellow fleshy sac surrounding each of the round seeds is sweet, juicy, and edible. Introduced to Ceylon in 1910.

Averrhoa Bilimbi. Cucumber-tree; Bilimbing; Biling, *S*; Bilimbikai, *T*. *Oxalidaceae*, Sorrel family. A small fine-foliaged tree, native of the Moluccas, commonly cultivated in the tropics, especially in the East, for its fruit, which is about 3–4 in. long, resembling a small green cucumber; it is produced in clusters on the trunk and oldest branches, and esteemed in pickles and preserves, being sometimes used for making jam and cooling drinks. It is also much relished in curries. The tree thrives up to medium elevations.

A. Carambola. Carambola; Kamaranga, *S*; Tamarta, *T*. A small tree, similar to the above, native of the Moluccas and long cultivated in the East. The curious, ovoid, angular and fleshy fruit, 3–5 in. long and borne in great profusion, is, when ripe, of a rich amber colour, very juicy, and of a sweet-acid taste. It is sometimes used for making jelly, preserves, etc., and a pleasant drink is made from it. The juice removes stains from linen and, like that of the preceding species, is also commonly used for burnishing brass. Some varieties bear agreeably sweet fruits; these should be propagated by gootee or grafting, though usually the tree is raised from seed. (See *Recipes.*)



Akee (*Blighia sapida*). Showing fruit whole and in section.

Baccaurea (Pierardia) motleyana. Rambeh or Rambai of Malaya. *Euphorbiaceae.* A handsome tree of Sumatra, with large oval leaves, bearing long pendulous clusters of large smooth berries (yellow when ripe) along the older branches. The sweet-acid juicy fruit is relished by some people. Season, August–September. Sometimes cultivated in Malaya. Introduced to Ceylon in 1883.

Bactris (Guilielma) utilis. Peach-nut; Pewa; Pejibaye. A pinnate-leaved, slender, spiny palm, cultivated in Costa Rica, Ecuador, etc., for its fruit, which is used as an article of food. The fruit is borne in large clusters which weigh up to 25 lb. or more, not unlike large dates, each palm producing four or five clusters a year. The best varieties are said to be seedless, or contain only a small seed. Boiled in salted water, the mealy flesh of the fruit is eaten and relished, being nutritious and of a pleasant chestnut-like flavour. Suited to low and medium elevations.

Blighia sapida (Cupania edulis). Akee. *Sapindaceae.* A medium-sized tree, native of W. Trop. Africa, introduced and cultivated in the W. Indies for its edible fruit. The latter is bluntly triangular, about 3 in. long, bright red when ripe. The seeds, of which each fruit contains 1 or 3, are shiny-black and of the size of large peas. The edible portion is the firm, cream-coloured, fat-like substance (aril) developed in a succulent socket around the base of the seed.

This, when fried with butter, or boiled and flavoured with salt and pepper, is considered delicious. The fruit when ripe splits open, and must then be picked, as

on long exposure to the air the aril becomes discoloured and unsafe to eat; if under- or over-ripe it is equally risky. Between the lobes of the aril there is a pink integument, which must be removed when preparing for eating. The fruit should be picked in the morning, old or fallen fruits being discarded. The tree is suited to moist or semi-dry districts, up to about 2,000 ft. It is commonly grown in Jamaica, where the fruit is much relished by Europeans as well as natives, many preferring it, when nicely fried, to bacon and eggs as a morning dish. A specimen in the garden at "Temple Trees," Colombo, bears fruit freely twice a year, chiefly in April–June and September–October. The Akee is also sometimes cultivated in Indian gardens, but the fruit does not appear to be appreciated in the East.

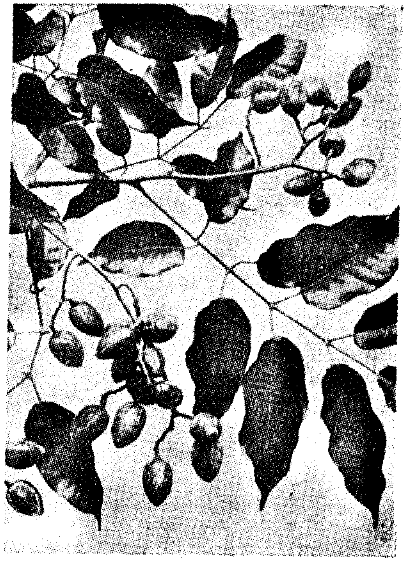
Bouea macrophylla. Kundangan. *Anacardiaceae.* A medium-sized tree of Malaya, producing a profusion of small, mango-like, edible fruits, of the size of a hen's egg, with thin skin and juicy flesh.

Canarium commune. Java Almond; Keanee (Papua); Kanari- or Pili-nut of the Philippines, etc.; Rata-kekuna, *S.* *Combretaceae.* A large, handsome, Malayan tree with small pinnate leaves, characterised by a remarkable buttressed trunk or laterally compressed surface roots; the latter develop into enormous erect flanges of nearly uniform thickness, so that solid circular sections may sometimes be cut out from them to form ready-made cart wheels. The tree is much cultivated for shade or ornament in Java, etc.

It bears in great abundance large pendulous clusters of fruits, of the size of small plums, dark purple when ripe; these are produced almost all the year round, but chiefly in June–August. The kernel is edible, resembling sweet almonds; it yields by expression an oil used for burning in lamps and for cooking. A considerable quantity of the "nuts," collected from wild trees, is said to be exported from the Philippines. A striking tree for planting in rows or avenues; thrives in hot and moist districts up to about 2,000 ft., and prefers deep, well drained soil.

Carissa Carandas. Maha-karanda, *S*; Perunkila, *T.* *Apocynaceae.* A small tree or large shrub, with sharp, forked thorns and small oval leaves, native of the dry region of Ceylon, also of India and Malaya. The fruit is dark purple when ripe, resembling a damson, and contains a number of small seeds. In India it is made into a pickle, also used for making excellent tarts and puddings, being considered to resemble gooseberries in flavour. When ripe, it makes a good jelly. Season, August–September. The plant is commonly employed for barrier hedges. Prop. from seed. Suited to dry districts.

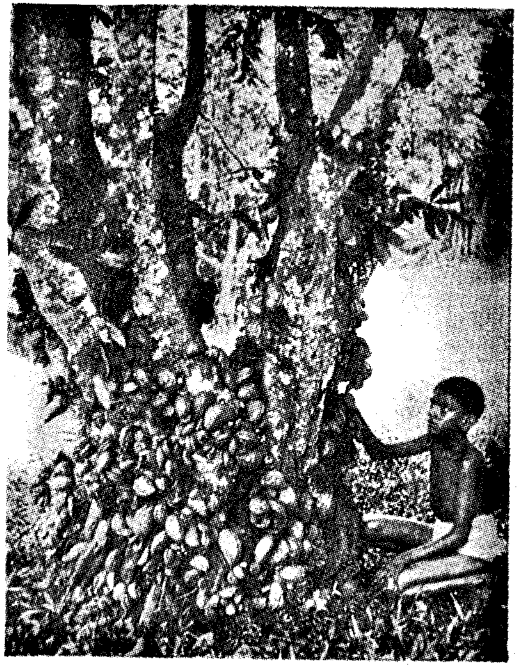
STAR-APPLE (*Chrysophyllum Cainito*). Showing star-like fruit in section.



KANARI OR JAVA ALMOND (*Canarium commune*).

C. grandiflora. Natal Plum; Amatingula. A large spiny shrub, similar to the above relative, commonly used for hedges in Natal, and the fruit is used in tarts, etc.

Chrysophyllum Cainito. Caimito; Star-apple; Rata-lawulu, *S*; Seemaipala-pallam, *T.* *Sapotaceae.* A large or medium-sized, handsome, evergreen tree of Trop. America and W. Indies, with striking dark green, oval leaves, which are coppery-yellow beneath. The purplish, smooth, round fruit is 2–3 in. in diameter, usually 4–6-seeded, the brown shiny seeds being ½ in. long. In an unripe state the fruit contains a viscous latex, but when fully matured the white, semi-transparent, jelly-like substance surrounding the seed is sweet and agreeable. The fruit when cut across presents a stellate form, the cells with their edible pulp radiating from the centre; hence the name "Star-apple." There are several varieties, differing in size and quality of fruit, etc. The tree is well worth growing for ornament or shade, and is commonly cultivated in the Western Tropics; thrives at Peradeniya, Ceylon, where it was first introduced in 1802. Prop. from seed.



NAM-NAM (*Cynometra cauliflora*). Showing fruit borne in masses at base of tree.

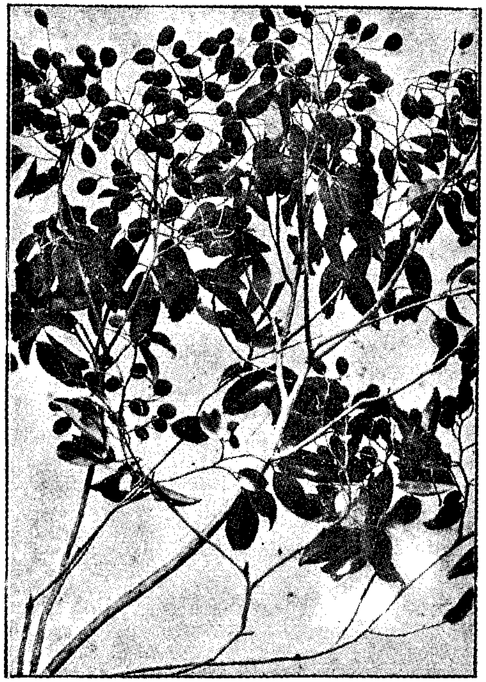
C. monopyrenum. Date-plum; Kos-eta-lawulu, *S*; Seemai-palapallam, *T.* A W. Indian tree, of more slender and upright habit than the preceding species, but resembling it in foliage; introduced at Peradeniya in 1814. As the vernacular names signify, the small, milky, sweetish fruit is of the form of a date or a jak seed, purplish-black when ripe. Season, February–April. Not worth growing as a fruit tree.

Chrysobalanus Icaco. Coco-plum; Icaco; Spanish Nectarine. *Rosaceae.* A large straggling shrub or small tree of Trop. America and W. Indies. Bears round, reddish-purple, plum-like fruits at the ends of the branches, each fruit having a large kernel covered with white, soft, sweetish but scanty pulp. Introduced to Ceylon in 1881. It has little to recommend it as a fruit, though it is said to be sometimes made into a preserve.

Citrus decumana. Shaddock; Pomelo; Forbidden Fruit; Jambola, *S*; Jamblica or Bambalinas, *T.* *Rutaceae.* A small tree, 25–30 ft. high, native of Trop.

Asia, commonly cultivated throughout the tropics for its large round or ovoid fruits. There are numerous varieties, varying in the shape and size of fruit, as well as in colour, flavour and juiciness of pulp; in some varieties the latter is green and acid, in others crimson, juicy and sweet. Some have few or no seeds. The fruit is sometimes made into jam. The tree grows luxuriantly in the moist low-country, producing fruit from 6 to 8 in. in diameter; thrives up to about 4,000 ft., either in moist or semi-dry districts. Seedlings are recommended as grafting-stock for oranges. The name Pomelo or Pumelo is generally used in the Eastern Tropics, and Shaddock in the W. Indies.

Clausena Wampi (*Cookia punctata*). Wampi; Rata-karapincha, *S. Rutaceae.* A small ornamental and aromatic tree, native of China. The pale yellow aromatic berries are sometimes made into a preserve, also used for flavouring meat curries. Suited to low and medium elevations. Prop. from seed.



Velvet Tamarind (*Dialium ovoideum*). Fruit velvety black.

Cynometra cauliflora. Nam-nam. *Leguminosae.* A shrubby, much-branched tree with small binate leaves, native of India and Malaya. The fruit is a large, wrinkled, thick, fleshy 1-seeded pod, rather semi-circular in shape, produced in large numbers on the trunk near the ground, or on the lowermost portions of the branches, chiefly in May–June. The succulent green or greenish-yellow flat pod is about ½ in. thick by 2–3 in. long; it is of a pleasant, sweet, sub-acid taste, suggesting an unripe apple, and is suited for stewing or pickling. The large flat seed yields a medicinal oil. Thrives in the moist low-country of Ceylon up to 2,000 ft., and prefers deep, rich soil. Though said to be indigenous to parts of India, it does not seem to be cultivated or well known there, for neither Firminger nor Cameron mentions it.

Davidsonia pruriens. Davidson's Plum; *Saxifrageae.* Queensland. A medium-sized tree with handsome serrate leaves. The plum-like fruits, bright pink when ripe, with a reddish flesh, are made into jam and preserves. Introduced to Ceylon in 1892.

Detarium senegalense. Dattock. *Leguminosae.* A tall, handsome tree of W. Trop. Africa, with small 1-seeded pods. The farinaceous pulp, intermixed with fibre around the bony shell of the seed, is edible and sweetish. A variety with bitter-acid pulp is considered poisonous. The tree furnishes excellent timber, formerly exported as African Mahogany. Introduced to Ceylon in 1885.

Dialium ovoideum. Velvet Tamarind; Gal-siyambala, *S*; Kallu-pullium, *T*; Kanji (Malaya). *Leguminosae.* A tall tree with pinnate leaves, indigenous to the semi-dry region of Ceylon, etc. The dark brown, small, velvety fruits are produced in large clusters, each fruit being about the size of a filbert. The thin, brittle shell encloses one or two seeds surrounded by a sweet-acid farinaceous pulp, which is edible and used in the preparation of chutneys, etc. When in season, chiefly April–May, the fruits are collected from uncultivated trees and commonly sold in the markets and boutiques. The tree affords a handsome dark red timber.

D. guineense. W. African Velvet-tamarind. Similar to the above, but distinguished by its larger leaves. The genus is characterised by the flowers having only two stamens, most Leguminous plants having ten or more. Introduced to Ceylon in 1893.

Dillenia indica. Honda-para, *S. Dilleniaceae.* A medium-sized handsome tree, with large wrinkled leaves and very large white flowers, native of Ceylon and Trop. Asia generally. Produces a profusion of large, round, green fruits (formed by the much enlarged, closely imbricate, fleshy sepals), each about 3–5 in. in diameter, being juicy and acid; these are used for making jelly and a cooling drink, also sometimes as a vegetable in curries. The tree is worth cultivating for ornament. Prop. by seed or cuttings. See fig. below.

Diospyros discolor. Velvet Apple; Mabolo. *Ebenaceae.* A medium-sized, slow-growing tree of the Ebony and Persimmon family, native of the Philippines. The velvety pink, round fruit is of the size of a large apple. The white fragrant pulp surrounding the large seeds is considered edible, though not very tempting. The tree, however, is attractive when in fruit. See fig. below.

Elaeocarpus edulis. *Tiliaceae.* A small ornamental tree, native of New Guinea, producing bright red fruit, 3–5 sharp-angled, ovoid in shape, 1-seeded and about 2 in. long. The outer scanty rind (pericarp) is of a sweetish-bitter taste, and may be made into a savoury jelly or used for pickling. The tree is worth growing for ornament, but scarcely as a fruit tree. Thrives in shady places with loose rich soil, up to about 2,000 ft. Prop. by seed.

E. serratus. Ceylon Olive; Veralu, *S*; Verali-pallam, *T.* An ornamental medium-sized tree, indigenous to Ceylon, producing smooth, ovoid, green fruits of the size of olives, which they rather resemble. The fleshy portion surrounding the stone (seed) is sub-acid and edible. In an unripe state it is used for pickling, like olives. Principal season, May–June. Thrives in the moist low-country up to about 2,000 ft., and is prop. by seed. See fig. over.

Eugenia Jambos. Rose-apple; Veli Jambu, *S*; Seeni-jambu, *T. Myrtaceae.* A medium-sized handsome tree, native of India and Malaya, introduced to Ceylon

Honda-Para (*Dillenia indica*). Showing (1) flowers, (2) fruit whole and (3) in section.

Velvet Apple (*Diospyros discolor*). Showing fruit whole and in section.

Ceylon Olive (*Elaeocarpus serratus*).

probably in the time of the Portuguese. The fragrant, pinkish-white fruit, about the size of a hen's egg, is of a sweetish rose water taste, and is said to be sometimes used in preserves. As a fruit, however, it has little to recommend it, being usually woolly and almost juiceless; but it varies somewhat in different varieties. Thrives in moist districts at medium elevations up to about 4,000 ft., preferring a deep, rich soil. (See *Wind-belt Trees.*)

E. Jambolana. Java Plum; Mahadan, *S*; Na-val, *T*. Large tree with grey bark; native of Ceylon, India, Malaya, etc., bearing small edible fruit. There are several varieties, some of which bear larger and more juicy fruits than others.

E. javanica. Wax Jambu; Pini Jambu, *S*. A small, ornamental, Malayan tree, producing clusters of pretty, glossy, rose-pink or pinkish-white, waxy-looking fruits. Each fruit is about the size of a large strawberry, with the base laterally compressed; it is sweetish-acid, but usually too fragrant and pithy to be agreeable. Prop. by seed. Thrives at low and medium elevations. Season, March–May. See fig. below.

Malay Apple (*Eugenia malaccensis*). Wax Jambu (*Eugenia javanica*).
Showing fruit of both whole and in section.

E. malaccensis. Malay Apple; Jambu, *S*; Peria Jambu, *T*. A handsome tree, 30–50 ft. high, with large oval leaves, indigenous to Malaya. Produces a great profusion of beautiful crimson flowers, the bright, numerous stamens forming a carpet under the tree as they drop. The pear-shaped, waxy-white or red fruits are in season chiefly in May–June. The snowy white, woolly pulp is edible, but not of much account. Thrives at low and medium elevations.

E. Michelii (= *E. uniflora*). Brazil- or Surinam-Cherry; Goraka-jambu, *S*; Pitanga. A small shrubby tree of Brazil, bearing small round and ribbed fruit, about 1 in. in diameter, rather flattened at the ends, of a bright red, waxy appearance. They are sweetish-acid and edible, but to most people are too aromatic to be agreeable; said to make good jelly, being also stewed or used in preserves. Thrives best at medium elevations, under sub-tropical conditions.

Feronia elephantum. Wood-apple; Elephant-apple; Diwul, *S*; Vila or Villati, *T*. *Rutaceae*. A small spiny tree, 30–40 ft. high, with small, glabrous, trifoliate leaves, native of India and Ceylon. The globular or ovoid fruit is of the size of a large cricket ball, similar to the Bael-fruit but distinguished from it by the rough, woody, hard, greyish shell. It contains a mass of soft, bitter-sweet, mealy substance, which is used for making a pleasant cooling drink and a preserve, also used in native medicine. Common in Ceylon throughout the dry region, being often cultivated. The fruit is collected under licence as a forest produce, and commonly sold in the markets. (See *Med. Plants*, also *Recipes*.)

Brazil Cherry (*Eugenia Michelii*).
Showing fruit whole and in section.

Flacourtia cataphracta. Rata-uguressa, *S*. *Bixaceae*. A small thorny tree, native of India and Malaya, producing round berries of the size of large cherries, purplish or deep red when ripe, and of a rather pleasant tart flavour. It is suggestive of "something better than a sloe, but worse than an indifferent plum." There are, however, several varieties in cultivation, and some would seem to merit a better description than this. The fruit can be made into a very agreeable jam or preserve. Prop. from seed, but a good variety should be raised by grafting.

F. Ramontchi. Ramontchi. Governor Plum (W. Indies); Uguressa, *S*; Katukali, *T*. A tree similar to the above, native of Ceylon, India, China, etc., bearing round dark purple fruits, which contain numerous small seeds. An excellent jelly is made from the fruit, and the tree makes a good barrier-hedge.

F. inermis. Lovi-lovi; Tomi-tomi; Louvi, *S*. An ornamental, thornless, Malayan tree, 25–30 ft. high, bearing in great profusion bright red, cherry-like berries, which are attractive-looking but deceptive, being exceedingly sour; they make good jelly or preserve, but require much sugar. Chief seasons in Ceylon, March–April and August–September. Prop. by seed; thrives in any moderately good soil at low elevations. Sow the small seed in boxes under cover; prick out the seedlings into baskets or bamboo pots when large enough. Seedlings take about 18 months or more to become ready for planting out.

Garcinia Cambogia. Goraka, *S*; Korrakkai-pulli, *T*. *Guttiferae*. A moderate-sized handsome tree, with a round head and drooping branches, native of the moist low-country of Ceylon and W. India. The large roundish fruit is of the size of an

Lovi-lovi (*Flacourtia inermis*). Berries glossy bright red.

orange, with several (usually 6–8) deep vertical furrows, forming blunt lobes; it is smooth-skinned, red or orange-yellow, and sweetish-acid. When ripe (June–July), it is commonly collected in the low-country of Ceylon, the thick succulent lobes being cut in sections, dried on mats in the sun, and preserved for use as required. It is largely employed for preserving fish, being made into a brine with salt; also used as a substitute for limes in curries. Thrives up to about 2,000 ft. Prop. by seed.

G. dulcis. Mundu. Similar to above. Jam is made of the fruit in Malaya.

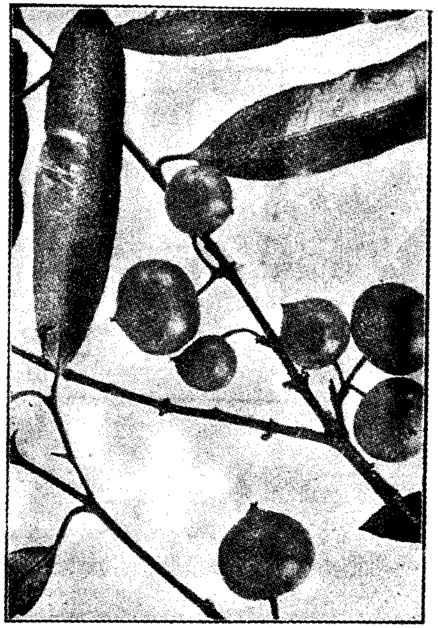
G. Xanthochymus. Egg Tree (from its conical shape); Cochin-goraka or Rata-goraka, *S*; Seemai-goraka, *T*. A symmetrical, bushy tree, 25 or 30 ft. high, native of S. India and Malaya; lvs. large, leathery, 10–15 in. long and about 3 in. broad. The attractive yellow smooth fruit, produced in great abundance, usually in December–February, is of the form and size of a small orange, with a pointed stigmatic projection at the end. The yellow juicy pulp is edible and has an acid but refreshing flavour. Prop. by the large, fleshy seeds, and thrives at medium elevations.

Genipa americana. Genip or Genipap; Mamoncilla; Marmalade-box. *Rubiaceae.* A medium-sized tree with large glossy leaves, producing an aromatic, russet-brown fruit, of the size of an orange, which is edible and makes a cooling drink, but must be kept after picking till it softens. Native of Guiana, often cultivated in Brazil, etc. Introduced to Ceylon in 1904.

Gnetum Gnemon. *Gnetaceae.* A medium-sized tree with opposite decussate leaves, botanically near the Coniferae. It is a native of Malaya and is often cultivated in Java, China, etc. for its fruit (seed), which is eaten boiled or roasted, being commonly sold in the shops. The flowers and leaves also are edible. Introduced at Peradeniya, Ceylon, in 1904, where it flowers freely, and fruited in 1929 for the first time.

Grias cauliflora. Anchovy Pear. *Myrtaceae.* A small, slender, unbranched, W. Indian tree, with a crown of very large drooping leaves, each about 3 ft. long by 6–8 in. across. The brown ovoid fruits, produced on the stem, are of the size of a hen's egg and considered edible, suggesting the mango in taste; said to be used for dessert or pickling. Judged by the fruit produced at Peradeniya, however, it is hardly worth being classed as edible.

Goraka (*Garcinia Cambogia*).



Cochin-goraka (*Garcinia Xanthochymus*).

Hibiscus Sabdariffa. Jamaica or Red Sorrel; Rozelle; Rata-bilincha, *S*; Pulincha-kira, *T*. *Malvaceae.* An annual shrub, 6–8 ft. high, with reddish stems, leaves and fruits, native of the W. Indies. Cultivated in most warm countries, sometimes as a catchcrop, for the sake of its large fleshy sepals, which remain after the flowers fall away (accrescent) and become enlarged and succulent, enclosing the fruit capsule; these make excellent jelly, considered to be almost equal to red-currant jelly. In an unripe state the fruit is adapted for pickles, and a refreshing beverage called "sorrel-drink" is prepared from it. The young, tender, acid leaves are sometimes used as a vegetable in curries. Thrives at all elevations up to about 4,000 ft. Seeds may be sown at the commencement of the monsoon rains, and the seedlings, when ready, planted out about 4 × 3 ft. The crop should be fit for picking in 5–6 months from planting, and continues for about 2 months. There is also a green form, known as "White Sorrel," with greenish-white fruits, but the former variety is considered to be more acid and is generally preferred. (See *Fibres.*)

Inocarpus edulis. Tahiti Chestnut. *Leguminosae.* A moderate-sized tree with large, shiny leaves, indigenous to the Pacific Isles, where the large fleshy seeds (one to two in each stout pod) form an article of food with the natives. The unripe seeds, boiled and roasted, are considered palatable, though "not suited to weak stomachs." The tree thrives and produces fruit in Ceylon, where it was introduced in 1861, but the fruit is not eaten there.

Lansium domesticum. Langsat; Langseh; Duku. *Meliaceae.* A moderate-sized, ornamental tree, native of Malaya; bears long, drooping clusters of closely packed berries, which have a thin tough skin, pale yellow when ripe, enclosing a scanty, aromatic, watery pulp, said to be relished in its native country, being "eaten fresh or variously prepared." It has been described as "one of the finest fruits of the Malayan Peninsula," but the fruit produced in Peradeniya Gardens, Ceylon, may be considered to be barely edible, though this may be only a poor variety. The tree seems to be little known in India. Thrives up to

Rozelle (*Hibiscus Sabdariffa*). Showing accrescent fleshy calyces.

2,000 ft. in moist districts. Introduced to Ceylon in 1869. Season, August–September.

Lucuma (Pouteria) Cainito. Abiu. *Sapotaceae*. A small tree of Brazil, resembling the Canistal in general habit of growth, and the Sapodilla in the fruit, which is ovoid or round, 2–4 in. long, bright yellow when ripe and described as "melting and sweet." Cultivated in Peru and Brazil; suited to medium elevations.

L. (Calocarpum) mammosa. Mammey Sapote; Grosse Sapote; Marmalade Fruit. *Sapotaceae*. A tree 30–40 ft. high, with fulvous grey branches and long, obovate, pointed leaves, native of Cent. America, cultivated in the latter country and in some W. Indian islands for its fruit, which are borne in clusters on the stem. The fruit is ovoid, 3–5 in. long, russet-brown, containing one or more polished seeds embedded in the pulp, which is sweet and of a reddish tint when fully ripe, like its ally the Sapodilla. It is made into a marmalade, which is said to be "not unlike an apple preserve." The seeds are said to be used in America with cocoa for making chocolate. The common names of this tree are often confused with those of *Mammea americana* (*q.v.*).

LANGSAT (*Lansium domesticum*).

L. nervosa. Canistal. A small tree, 15–25 ft. high, native of Cuba and Trop. S. America. The fruit is round to ovoid, 2–4 in. long and orange-yellow; it is popular with some people, but too sweet and musky for others. Prop. by the dark brown, ovoid, shiny seeds. Suited to medium elevations or warm sub-tropics.

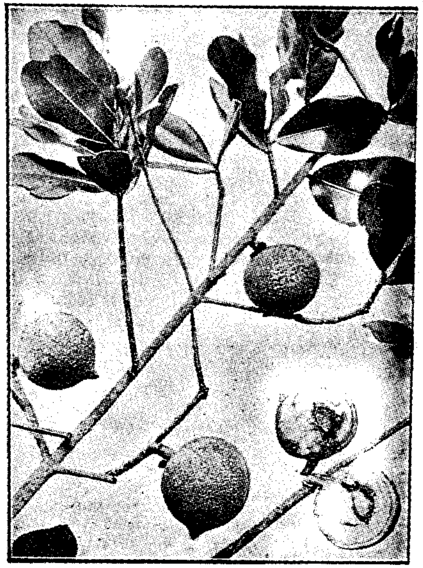
MEXICAN SAPODILLA (*Lucuma Palmeri*). Showing fruit whole and in section.

L. Palmeri. Mexican Sapodilla. A medium-sized tree with long, narrow and closely set leaves, native of Trop. S. America. The large, round or ovoid, smooth-skinned fruit, yellow when ripe, consists of a mass of yellow pulp, with one or more large brown ovoid seeds; it is relished in its native country, but is of indifferent quality in Ceylon, where it is sometimes grown in low-country gardens.

L. (Calocarpum) viride. Green Sapote; Injerto; Yash-tel. A tree of the Guatemalan highlands, similar to the above, but with fruit claimed to be superior to it. Suited to high or medium elevations.

Macadamia ternifolia. Queensland-nut. *Proteaceae*. A moderate-sized tree, about 40–50 ft. high, with dense, dark green, small, narrow leaves; native of N.-E. Australia, producing hard, round nuts, of the size of marbles. These have an agreeable flavour and are much relished in Australia, being sometimes retailed in Sydney at from 8*d*. to 10*d*. per lb. The hard, smooth shell is difficult to break, which is a drawback. The tree is propagated from seed; thrives and bears fruit at Peradeniya, Ceylon, where it was introduced in 1868. Suited to medium elevations.

Mammea americana. Mammey Apple; St. Domingo Apricot. *Gutti-ferae*, Mangosteen family. A small or moderate-sized, slow-growing tree, with large, leathery, shiny leaves, and white, scented flowers, native of Trop. America and the W. Indies. The fruit is nearly spherical, 3–5 in. in diameter, with thick, brown, bark-like skin, and a distinct pointed nipple towards the apex. It contains one large seed (sometimes two), surrounded by a layer of fibrous matter, next to which is the dense, orange-coloured, sweetish and slightly aromatic pulp, which may be stewed, preserved with sugar, or eaten raw. The small cream-coloured, scented flowers yield by distillation a spirit used in flavouring the liqueur Eau-de-Creole. The fruit has been described as rivalling the mangosteen, for which there is no justification. It would seem, however, to be a promising fruit for improvement by selection and cultivation. The tree has been grown at Peradeniya, Ceylon, since about 1810, and bears fruit annually.



MAMMEY APPLE (*Mammea americana*). Showing brown fruit whole and in section.

CERIMAN (*Monstera deliciosa*).

Muntingia Calabura. Calabura; Jam-fruit. *Tiliaceae*. A small or medium-sized, rather ornamental spreading tree with pinnate, pubescent, glandular leaves and small white flowers, native of Trop. America. The small yellow berries are said to make good tarts or jam. An infusion of the leaves is used as tea in Caraccas. Introduced to Ceylon about 1912.

Melicocca bijuga. Honey Berry; Spanish Lime; Ginep; Mamoncillo (Cuba). *Sapindaceae*. A handsome medium-sized tree of S. America, with small, pinnate leaves, cultivated in the W. Indies. The small, green, ovoid fruits, about 1 in. long, have a sweetish aromatic taste and are popular in Cuba, Porto Rico, etc. Best suited to medium elevations. Introduced to Ceylon in 1907.

Mimusops Bojeri. *Sapotaceae*. A slow-growing tree with small ovate or obovate, leathery leaves, shiny above and satiny grey beneath. The fruits, produced in November–December, are of the size of small plums, borne in clusters at the ends of the branches, each containing from two to four oblong brown seeds. The pulp has a sweetish taste, not unlike that of the Sapodilla.

Monstera deliciosa. Ceriman. *Aroideae*, Arum family. A noble epiphytic creeper with very large, scalloped and perforated leaves, native of Mexico. It produces in the axils of the uppermost leaves a cone-like fruit (spadix), 7–9 in. long, which is edible though rather juiceless, and has a pleasant pineapple-like odour when ripe. It is characterised by the presence in the pulp of spicules of calcium oxalate which cause an uncomfortable itching in the throat, and consequently detract from the eating qualities of the fruit. It is, however, relished by some, and is said to be sold in the markets in Java, etc. The plant grows best on stout tree-trunks or rough-barked trees, and may be propagated by cuttings placed in a mixture of old bark and leaf-mould at the base of the tree on which it is to grow. (See *Orn. Fol. Climbers.*)

Myrica cauliflora. Jaboticaba. *Myricaceae.* A small or medium-sized tree of Brazil, commonly cultivated in parts of that country for its fruit and for ornament. The small round fruit, produced in abundance on stem and older branches, is 1–1½ in. diameter, dark purple in colour, and crowned with a disk. The juicy pulp is of an agreeable vinous flavour and makes good jelly. It is esteemed in Brazil and commonly sold in the markets.* Suited to medium elevations or sub-tropical conditions.

GRANADILLA (*Passiflora quadrangularis*).

Nephelium (Euphoria) Longana. Longan; Mora or Rasa-mora, *S*; Nurai, *T*. *Sapindaceae.* A large spreading tree with smooth grey bark, native of the low-country of Ceylon, S. India, Bengal, Burma, and S. China. The aril surrounding the seed is edible and sweet, but inferior to that of the Litchi and Rambutan of the same family. Not cultivated in Ceylon. Season, September–October.

Noronhia emarginata. *Oleaceae*, Olive family. A small upright tree of Madagascar and Mauritius. The small olive-like fruit is considered edible. Introduced to Ceylon in 1882.

Oncoba spinosa. Onkob. *Bixaceae.* A small deciduous tree of Arabia and Trop. Africa. The fruit is sometimes eaten. Introduced at Peradeniya in 1883. Season, August–September.

Opuntia Dillenii. Prickly Pear. Also several other species. (See *Cacti*, also *Weeds*.) Fruit edible, but the tufts of small spines covering it are an objection.

Passiflora laurifolia. Water-lemon; Jamaica Honeysuckle; Pomme d'Or; Bell Apple. *Passifloraceae*, Passion-fruit family. A handsome W. Indian climber with entire, oval leaves, cultivated for the fruit or for ornament. The smooth, ovoid fruit is about 3 in. long and 2 in. diameter, orange-yellow when ripe and containing sweet juicy pulp, much esteemed for dessert or for making a sweet-cup. Readily prop. by cuttings, and especially adapted for growing as a screen against plant-houses. Introduced to Ceylon before 1824, but although it grows and flowers freely there, it rarely sets fruit, neither does it appear to be fruitful elsewhere in the East. (See *Orn. Climbers.*)

P. quadrangularis. Granadilla; Garandilla or Rata-puhul, *S*; Seemaisora-kai, *T*. A strong, quick-growing climber, with large oval leaves and square stems, native of Trop. America. The large, oblong, green or greenish-yellow fruit is not unlike a water melon, and contains

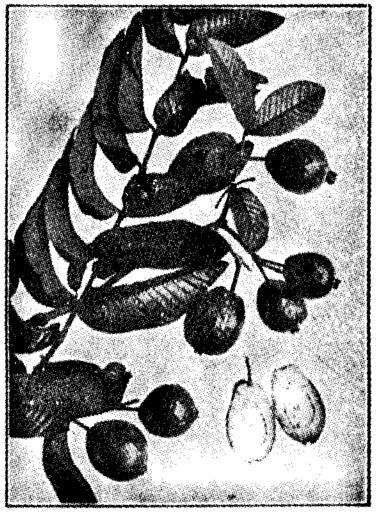
* Popenoe's Manual of Tropical and Sub-tropical Fruits.

in its hollow centre a mass of purplish sweet-acid, edible pulp, mixed with the flat seeds. In the unripe state the succulent shell may be boiled and used as a vegetable. The root is usually swollen and fleshy, and is sometimes cooked and eaten like a yam. The flowers are generally pollinated by insects, but these should be aided by artificial pollination in order to ensure a good crop of fruit. When the crop is over, the shoots should be cut well back, retaining only the stem and main branches. Propagated by seed or cuttings, and thrives up to 3,000 ft. or higher. It should be trained over a fence or trellis-work, or allowed to climb against trees with low spreading branches.

Phyllanthus distichus. Otaheite-gooseberry; Star-gooseberry; Rata-nelli or Siri-nelli, *S*. *Euphorbiaceae.* A shrub or small tree, with long graceful branches and feathery foliage, native of India and Malaya, often cultivated in low-country gardens in Ceylon. The pale green, round, faintly ribbed, acid fruit has a hard kernel, and is commonly used for pickling and making a delicious preserve. A crop is produced twice a year, in April and August. Propagated by seed. Suited chiefly to the moist low-country.

P. Emblica. Embal; Nelli, *S*. A small tree or large shrub with graceful, feathery foliage, native of Ceylon, India, Malaya, China, etc.; commonly found wild in open patana land in Ceylon up to about 4,000 ft., sometimes grown in gardens for ornament. The round, green, acid fruits, of the size of marbles, have a comparatively large kernel and are made into a much-esteemed preserve (see *Recipes*). The fruit is collected from plants in the wild state when in season, chiefly November–February, and usually sold at from 1*d*. to 1½*d*. per hundred.

Prosopis alba (Algoroba) and other species. *Leguminosae.* Thorny shrubby trees with bipinnate leaves, native of dry regions of Cent. America. The sweetish twisted pods are edible, but used chiefly as cattle food. Suited only to dry regions. (See *Fodder Plants.*)



GUAVA (*Psidium Guyava*). Showing fruit whole and in section.

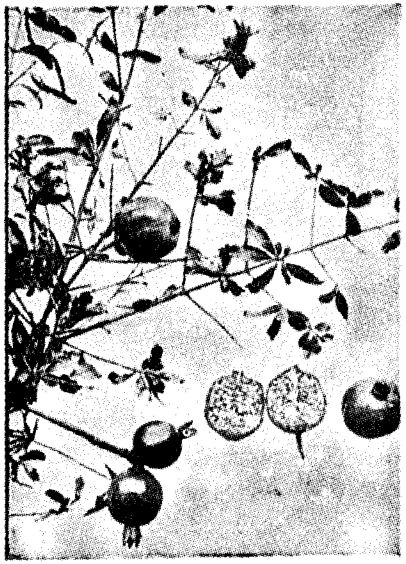
Psidium Guyava. Guava; Pera, *S*; Koiya-pallam, *T*. *Myrtaceae.* A large spreading shrub or small tree, 10–20 ft. high, native of Trop. America. The best cultivated varieties have large juicy fruits, round or ovoid in shape, becoming lemon-yellow when ripe, with a reddish or yellowish pulp mixed with numerous small seeds, and are usually of a sharp, tart flavour. The fruit may be used for jam or tarts, but its chief use is for making the well-known guava jelly. Propagation is by grafting, seed, or suckers. Thrives at medium or high elevations up to 5,000 ft. or higher, and in ordinarily good soil.

Varieties. Numerous varieties or species are known in cultivation. The "Pear-guava" bears a large, ovoid, succulent fruit of the form of a lemon, with a smooth yellow rind and pale green, aromatic pulp. "Kaffir-guava" is distinguished by a large, warted and furrowed fruit, not unlike a citron in appearance. "Apple-guava" (*P. pomiferum*) has a round, apple-like fruit with reddish pulp. "Strawberry-guava" (*P. cattleianum*) has small, round, reddish-purple fruits of a sweet, acid flavour, suitable for dessert (see *Sub-tropical Fruits*). "Guinea-guava" (*P.*

guineensis), a native of Guinea, is described as a "fulvous berry with red flesh, about the size of a nutmeg, of a pleasant flavour."

A wild form of guava occurs in Ceylon as a common weed in waste ground, bearing small round berries, chiefly from November to January; these are pale yellow when ripe, and are sold in the local markets under the name of "Embul-pera" (sour guava) at about 1*d.* to 2*d.* per hundred, being used for stewing and for making tarts or jelly.

Punica granatum. Pomegranate; Delun, *S*; Madalan-kai, *T*. *Lythraceae.* A small ornamental tree or large shrub, with large scarlet flowers, native of N. Africa and Mediterranean region, commonly met with in gardens throughout the East, thriving in dry districts or under sub-tropical conditions. The fruit is of the size of a large apple, with a tough rind, bright red or orange-yellow when ripe, and crowned with the persistent calyx lobes.



POMEGRANATE (*Punica granatum*). Showing red fruit in section, with closely packed seeds.

The juicy coating of the closely packed seeds is in some varieties of a sweet-acid pleasant taste, but usually it is scanty, tart, and astringent. In the tropics, however, the pomegranate is seldom seen at its best. Superior varieties are described as "almost seedless, very sweet, deliciously perfumed, and as large as an infant's head." The best I have seen in Ceylon were grown near the sea-coast, in dry districts. Propagation is best by layering or grafting, though plants are easily raised from seed. "Flowering pomegranate" is a variety with large, double, scarlet flowers, cultivated only for ornament. (See *Flowering Shrubs*, etc.)

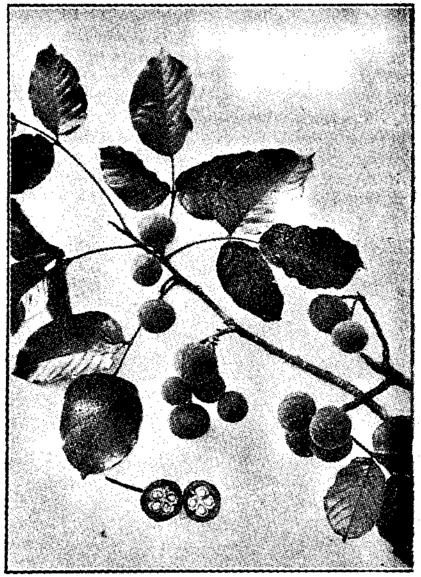
Rheedia lateriflora. Wild Mammey. *Guttiferae.* A medium-sized tree of Trop. America and the W. Indies, with large, leathery leaves, bearing round or ovoid, yellow fruits of the size of small mangosteens. The whitish pulp around the seeds is sweet-acid and edible. Introduced to Ceylon in 1896. Season, July–August.

Sandoricum indicum. Santol. *Meliaceae.* A handsome lofty tree of Malaya, with large trifoliate leaves, producing in June and July large clusters of yellow globular fruits, suggesting small oranges at a distance. Like the Rambutan, the soft but scanty white aril covering the seeds (usually five) is edible and of a sweetish-acid taste. Fermented and mixed with rice, an intoxicating drink is prepared from it in Malaya. Suited to hot and moist districts up to about 3,000 ft. (See p. 265.)

Sarcocephalus esculentus. Negro-peach; Rata-bakmi, *S*. *Rubiaceae.* A robust semi-climbing or spreading shrub, native of W. Trop. Africa, introduced to Ceylon in 1883. The round, brownish, warty fruit, produced chiefly in July–August, is about the size of an apple; the soft, reddish, watery pulp is said to be edible, but is not eaten in Ceylon.

Sideroxylon dulcificum. Miraculous Fruit. *Sapotaceae.* A tree of W. Trop. Africa, with sweet-acid fruits of the size of large olives, said to have the effect of changing an acid taste to sweet.

Sorindeia madagascariensis. Manguiera-a-grappes. *Anacardiaceae.* A large tree with pinnate leaves, native of Madagascar, Zanzibar and E. Trop. Africa, sometimes cultivated for the fruit, which is ovoid in shape, about 1 in. long, of a sweetish taste, with a trace of turpentine flavour. Introduced to Ceylon in 1911.



SANDORICUM (*Sandoricum indicum*). Showing yellow fruit whole and in section.

Spondias mangifera. Otaheite-apple; Hog Plum; Ambarella, *S*. *Anacardiaceae.* A small tree with handsome pinnate leaves, native of the Pacific Islands and commonly grown in Ceylon, India, etc. The round or ovoid fruit is of the size of a small mango, amber-coloured when ripe; it has a large stone (seed), surrounded by coarse fibre and a scanty acid pulp, "with a flavour like that of an exceedingly bad mango." But it makes an excellent preserve, and some varieties are better than others.

S. tuberosa. Imbu. A small tree, found in abundance on the dry plains of Brazil. The roots are swollen or tuberous, hence the specific name. The ovoid fruit, about $1\frac{1}{2}$ in. long, is eaten fresh or made into jelly.

Telfairea pedata. Telfaria-nuts; Mkweme. *Cucurbitaceae.* A large climbing gourd with a slender woody stem, reaching a height of 50–60 ft., native of Zanzibar and E. Trop. Africa. The fruit attains a size of $1\frac{1}{2}$–2 ft. or more in length and about 8 in. in thickness, with several sharp ridges along its length. It contains numerous, large, flat and nearly circular seeds, each about $1\frac{1}{2}$ in. across. These are eaten either fresh or roasted, and are said to be palatable. They contain about 36 per cent. of oil, much valued by the natives for cooking, etc. and said to be almost equal to olive oil. Propagation is by seed, which germinate within a week.

Terminalia Catappa. Country Almond; Kotamba, *S*; Kottai, *T*. *Combretaceae.* A handsome spreading tree, 40–50 ft. high, with large leathery leaves, native of Malaya, commonly grown in Ceylon and most tropical countries. The fruit is of the size of a plum, slightly compressed on two sides, and contains a 1-seeded kernel (drupe), which is edible and not unlike an almond. Firminger considered this to be "beyond comparison the most delicious nut of any kind India affords." The tree is deciduous twice a year and bears two crops annually before dropping its leaves, *i.e.* in June and November. Thrives from sea-level to about 2,000 ft. Propagated by seed. (See *Orn. Fol. Trees.*)

T. Okari. Okari-nut. A large handsome tree of Papua and New Britain, with large, fulvous, obovate leaves, bearing ovoid or

AMBARELLA (*Spondias mangifera*). Fruit borne in profusion when tree is deciduous.

obovoid fruit, about 7 in. long by 3 in. diameter, deep reddish-purple when ripe. The large kernel, surrounded by a fibrous shell, is about 3 in. long by $\frac{3}{4}$ in. diameter, and has a dark-brown testa. In its native home the nut is * much relished by all classes, being eaten raw or cooked, and prepared in different ways. "Probably one of the finest of tropical nuts." Introduced at Peradeniya in 1922.

Trapa bicornis. Water Chestnut; Ikiliya, *S. Onagraceae.* A low, aquatic, floating plant, common in the irrigation tanks of the dry region of Ceylon, also in Bengal, Malaya, Trop. Africa, etc. Said to be much cultivated in many parts of India for its nuts. Not cultivated in Ceylon, though the nuts are commonly collected and eaten by the poorer classes. The "nut" consists of the hard, two-horned, dark-brown or black fruit, in the form of a miniature bull's head.

Voa Vanga (*Vangueria edulis*).

Triphasia Aurantiola. Chinese Lime; Macanchi. *Rutaceae.* A small spiny shrub, native of S. China, semi-naturalised in parts of India. The small, red, berry-like fruit can hardly be considered edible, though in China, Ceylon, etc., it is made into a favourite preserve or crystallised fruit A good hedge plant.

Urceola esculenta. *Apocynaceae.* A woody climber of Burma, producing an edible fruit, also a blue dye; introduced at Peradeniya in 1881.

Vangueria edulis. Voa-vanga. *Rubiaceae.* A large, spreading shrub or small tree, native of Madagascar, producing an abundance of smooth, round, green fruits, of the size of a small apple, yellowish-green when ripe and of a sweet-acid taste, suggesting an unripe apple. Coolies and children eat the fruit when approaching ripeness. The large, shining, pale-green leaves are said to be used in medicine in Madagascar. Suited to the moist low-country up to 3,000 ft. Propagated by seed or cuttings.

Zizyphus Jujuba. Jujube; Masan, *S.* and Portuguese; Ilantai, *T. Rhamnaceae.* A small, thorny, spreading tree, native of Ceylon, India, Malaya, etc., found chiefly in dry districts. The fruit is borne in great profusion, chiefly in July–August, is of the size of a large cherry, yellowish in colour, with a hard horny kernel. The pulp surrounding the latter is rather pleasantly acid, and in India is said to afford "a very nice dish when cooked with sugar." In Ceylon, however, the fruit is usually eaten only by children. When dry, the pulp becomes farinaceous and is used in China and parts of Africa for making meal and bread. Suited to rather arid districts. Several varieties are cultivated in India and China. Propagated by layering or grafting. (See *Lac.*)

Z. vulgaris. A small thorny tree, native of Syria and Levant, said to be commonly grown about Calcutta and in most parts of India. The fruit is similar to the above and, though edible, has little to recommend it.

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CHAPTER XXI

SUB-TROPICAL FRUITS

SUITED TO HIGH OR INTERMEDIATE ELEVATIONS

(See also *Recipes for Jams, Preserves,* etc.)

Aberia caffra. Kei Apple. *Bixaceae.* A small thorny tree or tall shrub, native of S. Africa. The fruit is of the form of a small apple, yellow when ripe, and very acid. It is made into a preserve and in an unripe state is used as a pickle. Established at Hakgala Gardens, Ceylon, since about 1880, but has rarely fruited there, the climate being probably too wet for it.

Anona Cherimolia. Cherimoya or Cherimoyer. *Anonaceae.* A small tree of Peru, etc., introduced to Ceylon about 1880. The large, green, round, oblong or heart-shaped fruit, with a pitted rind, is 3–5 in. in diameter and weighs from 2 to 4 lb. It is a delicious fruit, somewhat resembling in appearance the custard-apple of the same family, and is known in Covent Garden Market, London, under that name, but it is far superior to the latter fruit. The cherimoyer has been described as one of the three finest fruits of the tropics, the other two being the mangosteen and pineapple. Dr. Lindley, however, considered that "one good pear was worth all the cherimoyers of Peru."

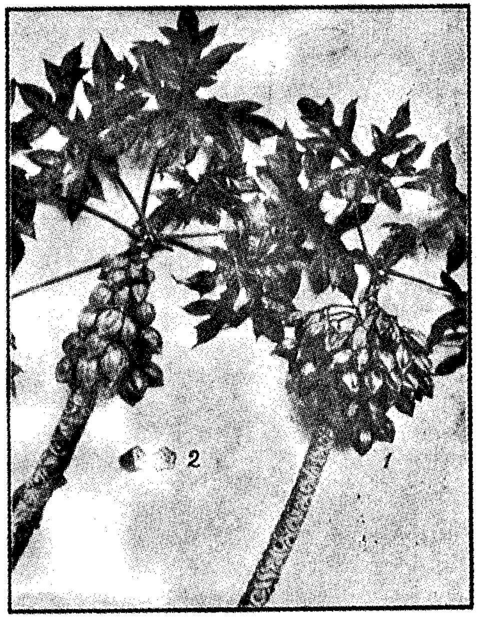
Cherimoyer (*Anona Cherimolia*). Showing green fruit whole and in section.

The tree is cultivated in many up-country gardens in Ceylon, especially in the Udapussellawa district, where the fruit ripens chiefly in June–July and October–December. In Madeira the Cherimoya, or a variety of it, is grown on commercial lines, being propagated by grafting. It may also be raised from seed, but the best varieties are almost seedless. The fruit is regularly exported under the name of "custard apple" from the Canary Is. to London, and retailed at about 6*d.* each. The tree is best suited to the hill districts, preferring a rather dry climate, and thrives

best on deep, rich soil. "Quotemoya" and "Atemoya" are varieties, which differ chiefly in the shape of the fruit, being oblong or ovoid.

Berberis vulgaris. Berberry. *Berberidaceae.* A spiny shrub, commonly grown in gardens for its flowers, but sometimes for its fruit. In the best varieties the scarlet berries are juicy, aromatic and seedless. It is valued in Italy and elsewhere for use in confectionery, etc. Propagated by layering.

Buchanania latifolia. Cheronjee. *Anacardiaceae.* A small tree, bearing simple, leathery leaves, native of the mountainous parts of Coromandel, Malabar, Mysore, etc. The pear-shaped kernels are sometimes used as a substitute for almonds, being considered superior to the cashew-nut, and a fine oil is expressed from them. They are sometimes sold in the bazaars in India at 2*d.* to 3*d.* per lb. The tree is not known in Ceylon; but a close ally, *B. angustifolia*, is indigenous here, though its fruit does not appear to be eaten.



Mountain Papaw (*Carica candamarcensis*). Showing green fruit whole and in section.

Carica candamarcensis. Mountain Papaw. *Passifloraceae.* A small semi-herbaceous tree with a crown of large, coarse, palmate leaves, native of Colombia and Ecuador, similar to the Papaw of the low-country, but with fruit only a fraction the size of the latter; introduced to Ceylon in 1880, and now commonly grown in hill gardens, being often found in a semi-naturalised state near up-country bungalows. The ovoid green fruit is characterised by blunt vertical ridges, and is in season all the year round. Though too acid for dessert, it is very agreeable when stewed, and can also be made into jam and preserves. When ripe, the fruit has a pleasant apple-like odour. Prop. by seed. (See *Papaw.*)

Carya oliviformis. Hickory; Pecan- or Pican-nut. *Juglandaceae.* A handsome, erect tree, attaining a height of about 70 ft., native of Texas, etc. The delicious nuts are much esteemed and form an article of trade in the S. United States. There are several varieties in cultivation. The tree, which is also noted for its tough elastic timber, has not as yet been established in Ceylon, nor apparently in Indian hill gardens, with the exception possibly of "one or two varieties under trial at Saharanpur Botanic Gardens." It requires a rather dry sub-tropical climate; thrives and bears well in the warmer parts of Australia.

Casimiroa edulis. Sapote or White Sapote; Mexican Apple. *Aurantiaceae,* Orange family. A medium-sized tree of Mexico and the highlands of Guatemala, characterised by palmately divided leaves and greenish flowers borne in racemes, introduced to Ceylon in 1899. The fruit of the best varieties is edible, being of the form of a medium-sized orange, and considered by some to have an agreeable flavour. The seeds are comparatively large and said to be poisonous; these as well as the bark and leaves are used medicinally.

Castanea chinensis. Chinese Chestnut. *Cupuliferae.* This tree, which bears a superior nut, has not been found suited to the hill districts of Ceylon, and is reported to have failed also in India. It requires rather dry sub-tropical conditions.

C. vesca. Spanish Chestnut. A handsome tree, commonly grown in hill gardens of N. India, where it produces in March–April panicles of lavender-coloured blossom, the fruit following in May and June. It has been established in some hill gardens in Ceylon, but does not appear to have yet fruited here.

Cerasus (Prunus) vulgaris. Cherry. *Rosaceae.* Although a species of Flowering Cherry (*Prunus Puddum*) grows freely at Nuwara Eliya, Ceylon, and flowers abundantly in January and February, every attempt to grow the Fruiting Cherry has proved a failure. According to Cameron, however, it can be grown successfully at some of the Hill stations in India. Certain species are indigenous to N. India and are said to yield fruit suitable for making tarts. "White Heart" is an old favourite dessert variety, and "Morello" a well-known sour cherry used for cooking.

Ceratonia Siliqua. Locust- or Carob-bean; St. John's Bread; Kharoub (Arabic); Algaroba (Spain). *Leguminosae.* A small spreading tree, 25–30 ft. high, with pinnate leaves, native of S. Europe, extensively cultivated in the Mediterranean region for its sweet, sugary pods, which are from 6–10 in. long, nearly 1 in. broad, dark brown in colour, and form a considerable article of export in the countries named. Being rich in sugar, they are a valuable fattening and nutritious food for cattle, but are also eaten and relished by human beings. The tree is a slow grower and of great longevity, "continuing productive for over 100 years." It is in its prime between 18 and 25 years old, when a single tree may produce as much as 2 or 3 cwt. of fruit a year.

Efforts have been made to establish the tree in Ceylon; but although specimens have existed for several years in some up-country gardens none has yet borne fruit worth speaking of. It is commonly grown or semi-naturalised in parts of N. India, and is being established in Queensland, S. United States, S. Africa, etc. The tree is usually dioecious, and in cultivation the best results are obtained by grafting selected varieties on seedling stocks; or male trees may have branches grafted on them from a female tree, reserving two or three male branches so as to ensure pollination.

Citrus Limonia. Lemon; Natran, *S*; Kidanar-attankai, *T*. This small-sized tree, native of N. India, is extensively cultivated in S. Europe, especially in Sicily and Spain, and more recently in California, for its well-known, acid, juicy fruit, which is usually ovoid in shape and pale yellow when ripe. The tree grows freely at medium and high elevations in Ceylon, but the fruit produced is invariably coarse and pithy, with a thick warty rind, and can seldom compare with the lemons of temperate countries. The long straggling branches, which the tree is liable to throw out, should be cut back so as to encourage the production of fruit-producing lateral shoots. Lemon fruits are very largely used for flavouring in confectionery and in the preparation of beverages, etc. The rind yields a valuable essential oil, and is also largely used for making candied lemon-peel. The tree requires conditions of climate and soil similar to those of the Orange (*q.v.*). Propagation is by budding or layering, but plants are easily raised from seed. Well-known varieties are *Eureka* and *Spanish*.

C. medica, var. Citron; Cidran, *S*. A small tree, much cultivated in S. Europe and the Mediterranean region for its large, round or ovoid fruit, which is usually about 4–6 in. in diameter, sometimes much larger according to variety. The "Fingered Citron" resembles a man's hand, with the fingers bent up as with cramp. The thick rind is the part used, this being prepared in brine, preserved in sugar, and largely employed in confectionery, preserves, marmalade, etc. Citrons are not commonly cultivated in the tropics, though good fruits may occasionally be met with in hill gardens. The leaves differ from those of other species of Citrus by not having the petiole distinctly winged. Propagated by budding, inarching, or seed.

C. Bigaradia (C. vulgaris). Seville-, Bitter-, or Marmalade-orange. A hardy, prolific tree, bearing large well-formed fruits, bright orange-yellow when ripe. Thrives and bears well at from 4,000 to 6,000 ft. in Ceylon, the cropping period extending from August–March. (See *Orange*, also *Essential Oils.*)

Crataegus stipulosa. Manzanilla. *Rosaceae.* A small tree of Guatemala, bearing small, apple-like fruits, yellow when ripe, used for tarts and preserves, also for decorative purposes.

Cydonia vulgaris. Quince. *Rosaceae.* A small deciduous tree, native of N. India and Asia Minor, cultivated in Europe, Syria, Mediterranean region, etc., for its fruit. The latter is of the size of an apple, often pear-shaped, yellowish when ripe, tart and rather astringent. It bears at the apex a prominent disc formed by the persistent and enlarged calyx. Prop. by cuttings or layering.

Cyphomandra betacea. Tree Tomato; Gas-Takkali, *S.* *Solanaceae.* An evergreen, semi-woody shrub or small tree, native of Peru, introduced to Ceylon in 1882. It has become thoroughly established in hill gardens and is commonly grown about Nuwara Eliya for market purposes. The egg-shaped and smooth-skinned fruit, produced in great abundance in hanging clusters towards the ends of young shoots, is in season almost throughout the year, but chiefly from March to May. At first greenish-purple, it changes in ripening to reddish-yellow. In the purple-fruited variety the fruit becomes a deep purple when ripe. The sub-acid succulent fruits are refreshing and agreeable when eaten raw, but their chief use is for stewing; they may also be made into jam. The tree is a quick-grower and commences to bear when 1½–2 years old, continuing productive for 5 or 6 years. Thrives best on deep and well-manured soil, and is propagated by seed or cuttings.

TREE TOMATO (*Cyphomandra betacea*).

Diospyros Kaki. Persimmon; Kaki or Date-plum. *Ebenaceae.* A medium-sized, slow-growing tree with large, handsome, ovate or cordate leaves, native of and commonly cultivated in China and Japan. The attractive, shining, smooth fruit is usually a bright orange-yellow when ripe, sometimes pink or dark purple. It is globular or pear-shaped, usually about 3 in. or more in diameter, containing 2 almond-like seeds; some varieties are seedless.

When perfectly ripe, or even slightly over-ripe, it has an agreeable flavour, being compared to an apricot with a suspicion of the medlar. In a less ripened state it is, in its native country, made into a preserve. Dried kaki fruits are said to be almost equal to dried figs. The tree thrives in the Riviera, whence excellent fruits are sometimes imported to London for the Covent Garden Market. It thrives and bears abundantly in parts of India, as at Calcutta, Saharanpur, etc., also in the drier up-country districts of Ceylon, where, however, the fruit is not much esteemed. First introduced at Hakgala Gardens in 1888, it occasionally bears fruit there, but the wet climate is apparently against it. The tree is usually dioecious, so that it is necessary to have a male tree in the neighbourhood of a pistillate one to ensure the latter's fertilisation. There are many varieties, which differ greatly in quality.

Feijoa sellowiana. Feijoa (Fay-zho-a). *Myrtaceae.* A shrub or small bushy tree, 10–15 ft. high, native of sub-tropical S. America, recently introduced into cultivation. It is closely allied to the common guava, which it resembles in the fruit. In California it is described as delicious in flavour. The fruit is ovoid in shape, about 2¼ in. long, rather fragrant, and is in season chiefly in November. "It can be used either raw, stewed, or made into jam or jelly."

Ficus Carica. Figs. *Urticaceae.* A small spreading, deciduous, shrubby tree with large leaves, native of Afghanistan and Asia Minor, cultivated in warm or sub-tropical countries, as Turkey, California, S. Africa, etc. The Fig grows moderately well and sets fruit in many up-country gardens in the drier districts in the tropics. It is hardly a success in Ceylon, owing to the humid climate and the absence of a cold season. In India, according to Firminger, "Fig trees are often met with, thriving vigorously and bearing fruit abundantly." These, however, though relished locally, can hardly compare with the figs of commerce.

The tree naturally flourishes in a dry sub-tropical climate with a hot summer and a brief cold period for wintering, when it is deciduous. Irrigation is usually afforded while the fruit is setting and growing, but stopped while ripening. No shade is necessary, but protection from strong winds is important. A deep clayey or loamy soil and free drainage are essential. The average yield of a Fig orchard is said to be about 2,000 lb. of fruit per acre.

Varieties. The "Smyrna," which is dependent for its pollination on a small wasp (see *Pollinating Insects*), which is bred in the wild or *Capri* fig, is well known. Others in cultivation are: *Golden Fig, Purple Fig, White Adriatic, Black Ischia,* etc. The tree is easily propagated by cuttings, which travel well by post.

Fragaria vesca. Strawberry. *Rosaceae.* A low, herbaceous, creeping perennial, producing "runners," by which the plant is naturally propagated. A species of wild Strawberry (*F. nilgerrensis*) is indigenous to the hills of S. India. This is probably identical with the Wild Strawberry found occasionally in patches at the higher elevations in Ceylon, especially about Hakgala and Nuwara Eliya, though in the opinion of Trimen the latter is an escape from cultivation.

Cultivated strawberries are grown in many up-country gardens, sometimes producing a crop of very fair quality, though the fruit is generally small and lacking in flavour. At Bangalore and other hill stations in India with a fairly dry climate good crops of strawberries are grown. Young plants, selected from "runners," are set out in rows, being spaced not less than 24 × 12 in. These should be renewed at least every second year, giving a change of soil each time. Rich loamy, well-drained and manured soil is best.

Varieties. Royal Sovereign, Laxtonian and British Queen are among the best.

Juglans regia. Walnut. *Juglandaceae.* A moderate-sized, pinnate-leaved tree, native of N. Asia, and S. Europe. It is cultivated commercially on the hills of N. India, also in Syria, California, etc., but is not a success on the plains or on the hills of S. India. It has been tried at Nuwara Eliya and Hakgala Gardens, Ceylon, without success.

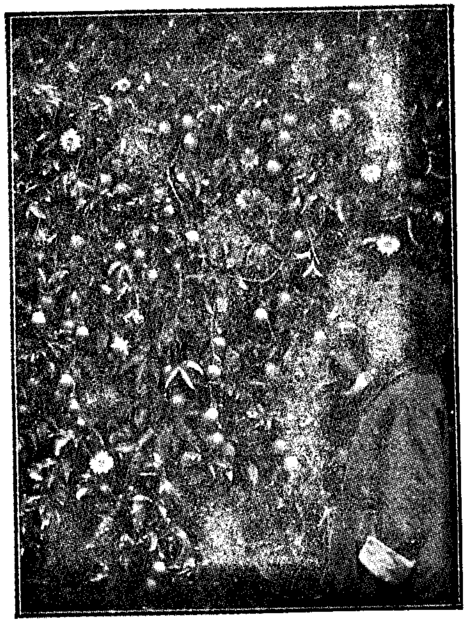
Morus indica. Indian Mulberry. *Urticaceae.* A moderate-sized, quick-growing tree, native of N. India, where it is commonly cultivated. The fruit resembles a small red pepper-corn, cylindrical in shape, rather deficient in flavour, and quite inferior to the European mulberry. It is commonly grown in Ceylon at medium and high elevations, but birds usually take most of the crop. The fruit, when obtainable, makes pleasant stews and tarts. Its cultivation in Ceylon villages was encouraged some years ago for the purpose of affording food, by means of its leaves, to the mulberry silk-worm. Easily propagated by cuttings. (See *Sericulture.*)

M. nigra. European or Black Mulberry. A large, spreading tree, native of the Levant, Syria and Persia, distinct from the above by its large cordate leaves and round fruit, like that of a bramble, almost black when ripe. It has been established

in some up-country gardens in Ceylon, but is seldom fruitful here. Occasionally, however, it bears fruit in the drier parts of Uva at about 5,000 ft.

Loganberry. A strong-growing, bramble-like plant, being a hybrid between the Blackberry and Raspberry, raised by J. H. Logan, of California, about 1898. It bears large, dark red, raspberry-like fruits, which are juicy and acid-sweet. Not commonly established in the tropics, being suited only to cool temperate conditions. In Kenya, however, it is said to grow and fruit to perfection at the higher elevations. Rich loamy soil and a moderately dry climate suit it.

Olea Europea. Olive. *Oleaceae.* A low, spreading tree, native of Asia Minor, extensively cultivated in the Mediterranean region, N. Africa, California, etc., both for the fruit, which is edible and largely used in preserves and pickles, as well as for the extraction by pressure or crushing of the valuable and well-known oil. Plants have been introduced to Ceylon and grown for many years without producing but an odd fruit occasionally. Neither has the Olive been found suited to the hills of S. India, and even in the dry climate of Bangalore trees 30–40 years old have remained unproductive; but in Queensland, S. Africa, and N. India it has become well established and bears fruit abundantly.



PASSION-FRUIT (*Passiflora edulis*).

Cultivation, etc. The Olive thrives under dry, warm temperate or sub-tropical conditions, in light soil on a limestone formation. It is susceptible to either a very hot or very cold climate. There are numerous varieties in cultivation, differing in the lateness or earliness of the crop, shape, size, and quality of the fruit, also in yield and quality of oil. It varies from round to ovoid, and from ¾ to 1 in. in diameter. Propagated by grafting or layering, occasionally from seed. The spacing usually recommended for planting is about 25 ft. each way, say 70 trees per acre. Where found to thrive the tree makes a good hedge.

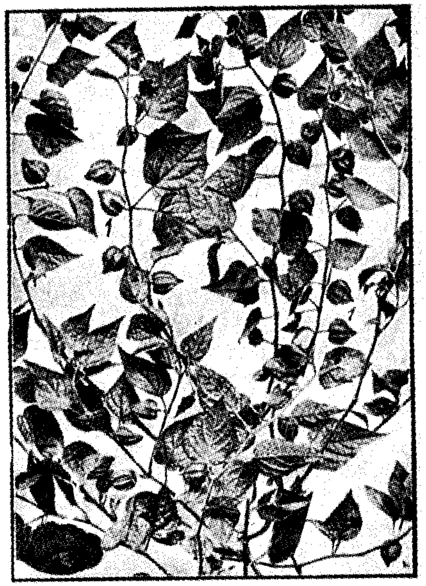
Yield. The trees normally take about 8 or 10 years to come well into bearing, and when mature and under favourable conditions may produce about 2,500 lb. or more fruit per acre, or an average of 50–60 lb. per tree, varying according to age, variety, climate and soil. The fruit is rich in oil, 100 lb. producing 25–30 lb. of oil, or an average of about 1½ gallons per tree. The price of the oil fluctuates round about 15*s.*–20*s.* per gallon.

Passiflora edulis. Passion-fruit; Sweet-cup. *Passifloraceae.* A perennial climber, native of S. Brazil, introduced to Ceylon and commonly cultivated up-country for the fruit or as a screen for out-houses, etc. As an escape from cultivation it may often be met with in a wild state at elevations of 3,000–6,000 ft. It bears in great abundance a smooth, ovoid fruit of the size of a hen's egg, purple when ripe, the rind afterwards shrinking and becoming much wrinkled. Two crops a year are sometimes produced, the principal season being from May to July.

The fruit contains in its hollow centre a quantity of fragrant, sweet, juicy pulp, inseparable from which are the small seeds; this, when emptied out of the shell and beaten up in a glass with a pinch of bicarbonate of soda and sugar, makes a delicious drink, resembling the Sweet-cup of the W. Indies. The fruit is sold locally at about 1*s.* per hundred. It is occasionally exported from Australia and elsewhere to London, but the shrivelled appearance which it assumes on ripening is against it for market purposes. The Passion-fruit may be cultivated successfully from 2,000 ft. upwards, and may be trained over a fence or trellis-work, or allowed to climb over trees, etc. Rich humous soil and a moist, sheltered situation suit it best. Prop. by seed or cuttings.

Photinia (Eriobotrya) japonica. (See *Loquat.*)

Physalis peruviana. Cape Gooseberry; Peruvian Cherry; Tippari. *Solanaceae.* A low, straggling or creeping herbaceous perennial, native of Peru, etc., nat. in S. Africa and to some extent in the hill districts of Ceylon, India, etc. The fruit is of the size and form of a small cherry, concealed in the dry, leafy, bladder-like persistent calyx. When quite ripe it is yellow and of an agreeable and refreshing flavour, being used for dessert, and makes a delicious jam. In S. Africa it is largely made into a delicious jam, which forms an article of export. (See *Recipes.*)



CAPE GOOSEBERRY (*Physalis peruviana*). (1) Bladder-like persistent calyx enclosing yellow berry.

The plant is easily raised from seed, and will thrive in any ordinarily good soil, but is most productive on a bank of rich sandy loam. Sow seed on a sheltered bed, and plant out seedlings in rows about 3 × 2 ft. Stakes or trellis-work should be provided for support, or the plants may be allowed to run over rocks. Suited to elevations of 2,000–6,000 ft. or sub-tropical conditions.

Pistacia vera. Pistachio-nut. *Anacardiaceae.* A small tree, reaching about 30 ft. in height, indigenous to Asia Minor, cultivated in Syria, Levant, N. India, Mexico, etc. for its fruit. The latter consists of a small thin-shelled ovoid capsule, containing the green "nut" (seed), which when roasted and served with condiments has a pleasant aromatic flavour. It is also exported for use in confectionery, etc. During the cold weather it is obtained in great abundance in the bazaars and coffee-houses throughout Asia Minor, being known as "Pista" or "Pistakion."

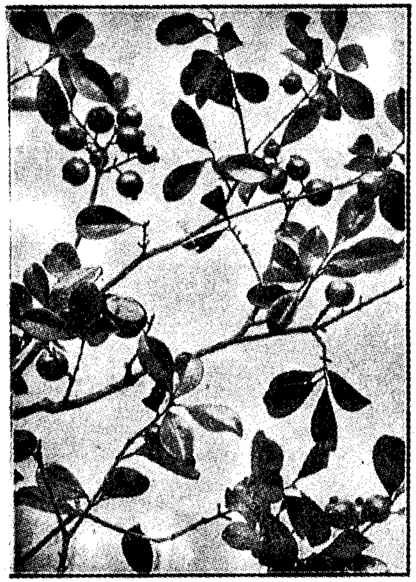
Prunus Armeniaca. Apricot. *Rosaceae.* The cultivation of this delicious fruit in Ceylon has so far been nowhere successful, nor does it seem to have been attended with much better results elsewhere in the tropics. It is best suited to the sub-tropics, and is commonly cultivated in Syria, Persia, Iraq, etc., being propagated by layering or grafting. The tree grows well and bears fruit on the hills in N. India. It is a native of N. China.

P. domestica. Plum. A small deciduous tree, whose native country is uncertain. In Ceylon, as in other parts of the tropics, the Plum has so far not been a success. Certain varieties have occasionally produced a few fruits about Nuwara

Eliya; but the crop seldom ripens satisfactorily, as the monsoon rains usually commence when it is approaching maturity, and the trees have generally been short-lived. In India, however, on the hills and in the N. Provinces, plums are grown with a greater measure of success, though the fruit is "hardly palatable, except when cooked or preserved." Cameron says: "Of many kinds tried at Bangalore, Kirk's Blue, Greengage, and Golden Drop have been reported to thrive best." At Nuwara Eliya, Red-heart (a cooking variety), Alucha, and Greengage have given the best results. Victoria, Pond's Seedling and Golden Drop are favourite varieties in cool countries. Cultivation similar to that of the Peach.

P. bokhariensis. Bokhara Plum. A species of Plum indigenous to N. India. According to Firminger, "quantities of the fruit in a dried state are annually brought down from Cabul. The tree grows vigorously in the Upper Provinces and is very common in gardens in the Punjab, where it bears abundantly." Cameron adds that it is also successfully cultivated on the hills in S. India, the fruit being made into a good preserve, or stewed.

P. Capollin and **P. salicifolia.** Small slender, erect trees of S. America, the fruits of which, known as Capulin, resemble cherries and are relished in their native habitat.



PURPLE GUAVA (*Psidium cattleianum*).

P. Persica (Persica vulgaris). Peach. A small slender tree, supposed to be a native of China. The Peach in the tropics is, at best, very different from the large, luscious, melting fruit it is in temperate and some sub-tropical countries. It may, however, be grown with appreciable success in suitable localities at elevations of 4,000–5,000 ft., as in the drier district of Wilson Bungalow, Ceylon, where moderately good fruits, at any rate for stewing or jam, are obtained and sold in the local markets. No systematic cultivation, however, is followed here, the trees being propagated by cuttings, with but little regard for selection and cultivation. Peaches are grown as orchard crops in California, S.E. Canada, S. Africa, Australia, etc.

At Bangalore, Cameron mentions "an excellent variety called Indore," and states: "It is a great point in the cultivation of the Peach to keep the roots as little below the surface of the soil as possible. This is sometimes effected by placing tiles underneath where the trees are planted." The tree should be propagated by grafting on strong seedling stocks, but may be raised by cuttings from fruiting branches or, if desired, by sowing the kernels (stones) of the fruit. Plants from grafts or cuttings always come into bearing earlier. Seedling plants take three or four years to come into bearing. Among the best varieties are: Royal George, Estella, Florida Gem, Imperial, Shackleford, and Peen-to or "Flat Peach" of China.

Psidium cattleianum. China-, Purple-, Strawberry-, or Calcutta-guava. *Myrtaceae.* A small, shrubby, ornamental tree, 20–25 ft. high, with smooth, grey bark and small, leathery, shining, obovate leaves, native of S. America. The date of its introduction to Ceylon is not recorded, but that of its first discovery is given as 1818. It has been

grown at Peradeniya and Hakgala Gardens since about 1870, and is now often met with in up-country gardens. Cameron does not mention it for S. India, which is remarkable considering its good qualities.

The fruit is probably the most palatable of all the guavas, and deserves to be widely known. It is of the size of small plums, deep claret-coloured when ripe, with soft, juicy, purplish-red pulp, which has an agreeable flavour, though scarcely suggesting a strawberry. It is an excellent fruit for tarts, jam, or jelly, and may also be relished raw. The tree thrives and bears fruit freely at elevations of 2,000–5,000 ft., producing two crops a year. With good cultivation, the size and quality of the fruit is considerably improved. Usually propagated by seed, but the best trees should be increased by layering or grafting.

Pyrus communis. Pear. *Rosaceae.* Certain varieties of Pear grow and bear well in many parts of the tropics, at medium elevations and on the hills, but the fruit is usually hard, woody, and lacking in flavour.

In many hill gardens in Ceylon a variety of cooking-pear has become well established, thriving with but scanty attention and producing, during February–April, fairly heavy crops of large, coarse fruits, which can only be eaten when stewed with a liberal addition of sugar. Cameron, however, states: "At Simla and other hill stations in India, the Pear can be brought to great perfection under cultivation," and advises pruning the trees in February, just before they burst into leaf. In Ceylon the trees are practically evergreen. They may be propagated by cuttings, layering, or grafting, and like deep, rich, loamy soil. Well-known varieties are: Beurre d'Amanlis, Pitmaston Duchess, and Wm. Bon Chrêtien.

P. Malus. Apple. The cultivation of the Apple has at different times been tried in Ceylon, more especially in the vicinity of Nuwara Eliya and Bandarawela, but so far with little success, the climate being apparently quite unsuited to the tree. On the hills in India, according to Cameron, "apples can be cultivated to perfection." This is a statement which will probably not be generally confirmed, although the writer has seen very fine samples of apples from Kashmir, etc. In the uplands of Kenya, excellent crops of good apples are said to be produced.

The tree is usually propagated by grafting, but may be raised by layering or cuttings, and a deep loamy soil suits it best. In India it flowers in February–March, and the fruit ripens in May–June. The roots are laid bare in January, and after an interval of a fortnight are again covered with a mixture of manure and good soil. Copious watering is given at the root when the fruit is swelling. Well-known varieties are: Worcester Permain, Ribston Pippin, Golden Russet, Jonathan, James Grieve, Laxton Epicure.

Rhodomyrtus tomentosus. Hill-gooseberry; Hill-guava. *Myrtaceae.* A handsome shrub with small, thick, oval leaves, indigenous to the hills of Ceylon, S. India, and Malaya. It produces a profusion of pale pink flowers, followed by small round pale yellow berries; from these a jelly is made, which in flavour "somewhat resembles apple-jelly." Propagated from seed. Not suited to low elevations, but an acclimatised variety thrives at Peradeniya (1,500 ft.), where it is grown as an ornamental shrub, which seldom, however, bears fruit. (See *Flowering Shrubs.*)

Ribes grossularia. Gooseberry. *Saxifrageae.* Plants of this small, spiny bush have been imported both from England and Australia, and planted under the most favourable conditions available in the Experiment Garden at Nuwara Eliya, as well as at Hakgala Gardens, Ceylon. They grew for a time, but failed in each case to become properly established. The climate of the tropics in general is evidently unsuited to the plant.

R. nigrum. Black Currant. The same remarks as under Gooseberry apply.

Rubus lasiocarpus. Ceylon- or Wild-Raspberry. *Rosaceae.* A large, straggling bramble, sometimes wrongly called Loganberry, characterised by a white down which entirely covers the stems, indigenous to the hills of Ceylon, India, and Java. The small fruit rather resembles the Raspberry proper, but has very little flavour, and its hairy character is against it. In India it is said to be frequently collected and made into tarts, and is in great demand at Simla and other hill stations

for jam. The plant likes deep, rich soil, and should be supported on a fence or poles. Propagated by cuttings, or by suckers dug up during the rains.

R. macrocarpus. Ceylon Blackberry. A hairy, prickly bramble, common at medium and high elevations in Ceylon. The large, dull purplish-red or bright red fruits are juicy and when quite ripe have a good flavour.

R. rosaefolius. Mauritius Raspberry. A shrub, considered to have been introduced from Mauritius, said to be commonly grown in gardens about Calcutta. The fruit, produced in February, is similar in appearance to the Raspberry, but is filled with hard seeds and, according to Firminger, "has no better flavour than a bad blackberry." Hooker gives this as an indigenous species for India.

R. Idaeus. Raspberry. This has been tried at Hakgala and Nuwara Eliya Gardens in Ceylon, but found quite unsuited to the climate. The same remarks as under Gooseberry may be applied. "Lloyd George" is a well-known variety.

R. trivialis. American Dewberry. I am not aware that this has been tried in Ceylon; it has been reported to grow vigorously and bear fruit at Saharanpur.

Vaccinium meridionale. Jamaica Mulberry. *Vacciniaceae,* Cranberry order. This is of the size of a Black-currant and is used in Jamaica for tarts, jam and jelly. Other species which yield edible fruits are the Cowberry (*V. Vitis-idaea*) and Whortleberry (*V. myrtillus*). The Cranberry is produced by *Oxycoccus palustris* and *O. macrocarpus*, the latter a Canadian species.

Vitis vinifera. Grapes, or Grape-vine. *Ampelidae.* The Grape-vine is extensively cultivated in S. Europe, where it is indigenous, also in Asia Minor, N. and S. Africa, Australia, S. United States, and to some extent in all warm latitudes. In cool countries it is grown in glass-houses (vineries), the finest dessert grapes being produced under these conditions. In N India grapes of very fair quality are grown, both from exotic and indigenous sorts, while in the dry northern part of Ceylon certain varieties are being cultivated with some degree of success. Here, the want of a winter's rest, which is so essential to the plant, is partially provided for by periodically baring the roots and exposing them for a few weeks. This practice is carried out once a year, at the time of the principal pruning, after fruiting, as in the case of the mango in India.

Cultivation. It has been shown conclusively that a hot and moist tropical climate is unsuited to the successful cultivation of the crop. Conditions essential for its success are a fairly dry and warm temperature, a rainfall not over 40 in., a calcareous soil, and a cold season for resting or wintering. A climate somewhat approaching these conditions, except the wintering, obtains in parts of the tropics, as at Bandarawela in Ceylon (4,000 ft.) and the higher elevations in Kenya, etc. Moisture at the roots, as by irrigation, is essential during the active growing period; this should cease when the fruit commences to ripen. In vineyards the canes are usually planted in rows (about 5 × 4 ft.), tied to stout stakes when grown on the bush system, or allowed to trail over the ground when on terraces or steep hillsides, as in Syria, etc. In glass-houses, however, they are grown as climbers and supported by means of strands of wire stretched horizontally about a foot from the glass roof. In Jaffna, the vines are usually trained over a trellis-work or pandal of bamboos.

Propagation. The Grape-vine is best propagated by what is known as "Siamese" grafting on American stocks, which are considered to be resistant to the *Phylloxera* or Root-louse pest. But it may be readily raised by cuttings 12–15 in. long, inserted slanting-wise in the soil to about ⅓ their length, leaving about 3 buds above the surface, the earth being well pressed around them.

Pruning and *Thinning.* The usual pruning is carried out after the crop is over and the leaves have dropped, all lateral shoots being pruned hard back to within two or three buds of the main stem, and strong-growing shoots shortened to

half their length. Excessive growth should afterwards be thinned out when the vines are in bearing. In vineyards the plants are pruned back each year to a single stem about 4 ft. high. The berries should, when young, be thinned out by means of a pair of fine scissors, and the bunches also, if too numerous, reduced in number in order to produce larger bunches and better berries. Eight or ten bunches is considered a sufficient crop for one vine to carry.

Manuring. The plants respond to liberal treatment, but are not greedy feeders. A friable loamy soil on a limestone formation suits them, and some well decomposed cattle manure may be forked into the soil around the vines once a year. In India, as well as in Jaffna, fish manure is considered the best, and salt in small doses is sometimes applied. (See *Salt.*) The following ingredients form a good stimulating mixture: muriate of potash, superphosphate, and sulph. of ammonia, in the ratio of 2 : 1½ : 1. The mixture may be applied at the rate of about 4 oz. each for young plants, or 2–3 lb. for mature vines.

Varieties. The numerous cultivated varieties of the Grape-vine are considered to belong to *Vitis vinifera.* Several species of *Vitis* are indigenous to Ceylon, but none of these can be considered edible, except perhaps *V. indica.* The fruit of the latter somewhat resembles *V. vinifera,* but has a bitter flavour. The Black Hambro (dark purplish fruit) and Muscat of Alexandria (pale green berries) are grown in the northern part of Ceylon. Gordo Blanco (white), closely resembling white Muscat of Alexandria, has been found to bear fruit at Bandarawela, Ceylon (about 4,000 ft.). In the Deccan, Fladi, Pandhari-sahebi, and Bokhari are among the best, the last named being the most prolific. Grapes are grown with some success in parts of the W. Indies, the most successful varieties including Barbarossa, Muscat Hamburg, and Gros Colman. Alicante (black) and Almeria (white) are also good sorts. The "Currant grape" is a seedless variety of the ordinary Grape-vine. It occurs in different forms, as Zante Currant, Cape Currant, etc.

Yield. In Jaffna, Ceylon, two crops a year are obtained, the principal one in March, and the second in September. The fruit takes 3 to 3½ months to ripen, from the time of flowering, the vines (which grow to a large size) each producing an annual crop of from 50 to 80 lb. or more; the crop is sold at prices varying from 25 to 30 cents (= about 4*d.* to 6*d.*) per lb. Where grapes are grown commercially, as many as 2,500 vines are planted to the acre, and the yield is about a bushel of grapes per 10 vines, or the equivalent of about 240 gallons of wine per acre.

CHAPTER XXII

TROPICAL VEGETABLES AND FOOD-CROPS

SUITABLE FOR LOW OR MEDIUM ELEVATIONS.

VEGETABLES of one kind or another can, with a little trouble, be grown in all parts of the tropics where any other cultivation is possible. While certain temperate vegetables, such as beetroot, celery, leeks, carrots, parsnips, cabbages, globe-artichokes, etc., thrive almost to perfection in the cool moist climate of the higher elevations, several of these may also be grown at lower altitudes, or even at sea-level, with some degree of success, if sown at suitable seasons and supplied with the necessary amount of moisture and shade. Tropical vegetables are, of course, suited chiefly to low or intermediate elevations, and many of these are well worth cultivating, as may be seen from the following selections.

Deep alluvial and well-drained soil, as on flat low-lying land or near river banks, is the best for vegetables generally. Where this does not exist, a condition approaching it may usually be obtained by the application of humous material, organic manure, sand, etc. (See *Manures.*) A loose, deep, sandy soil is essential for deep-rooting vegetables, such as carrots, parsnips, celery, etc. Frequent stirring of the soil, weeding, watering (or irrigation) and earthing up when necessary, are indispensable to the successful cultivation of vegetables generally. At low elevations light shade from the noon sun, especially for temperate kinds, is usually beneficial, and shelter from strong winds is also important.

The use of suitable fertilisers (*q.v.*) is usually amply repaid, not only by a larger yield but also by a better quality of crop, and in the case of clayey soil periodical liming is beneficial. Root crops generally are benefited by a small application of a potash fertiliser at intervals of a few weeks while the crop is growing.

For convenience of reference the following are grouped thus :

(1) *BEANS, GRAMS, AND PULSES.* (Leguminosae.)
(2) *GOURDS, PUMPKINS, ETC.* (Cucurbitaceae.)
(3) *ROOT- OR TUBEROUS-VEGETABLES.*
(4) *MISCELLANEOUS VEGETABLES AND FOOD-CROPS.*
(5) *CEREALS OR DRY GRAINS.*
(6) *ANALYSES OF PULSES, CEREALS, ETC.*
(7) *EDIBLE FLOWERS OF THE TROPICS.*
(8) *EDIBLE HERBS, ETC., COMMONLY USED AS FOOD IN CEYLON.*

BEANS, GRAMS, AND PULSES (*LEGUMINOSAE*)

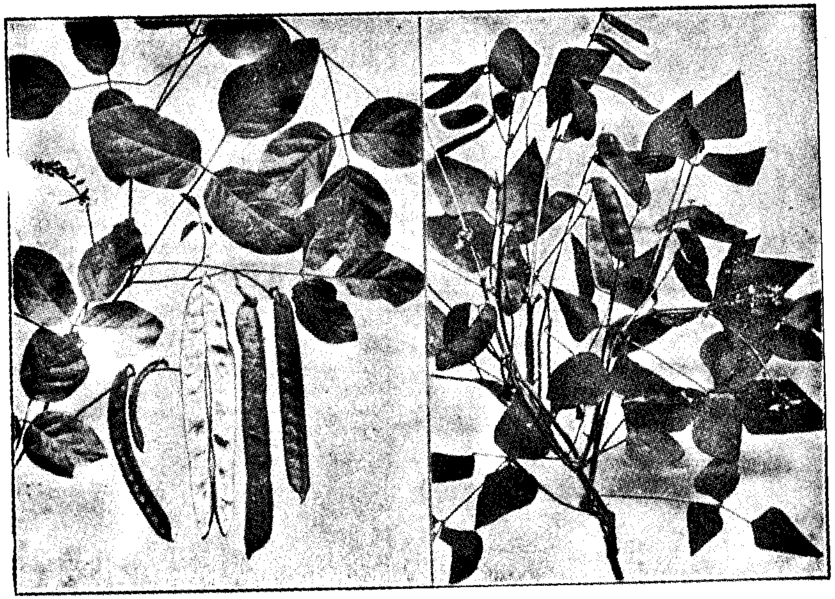
USUALLY CULTIVATED AS MIXED OR CATCHCROPS, IN SOME CASES AS GREEN-MANURE CROPS.

Cajanus indicus. Pigeon Pea; Congo-bean; Red-gram; Dhal or Dhol; Rata-tora, *S*; Thovaroy or Paripu, *T*. A perennial shrub, 6–8

ft. high, with thin wiry branches and narrow trifoliate leaves, native of India; commonly cultivated in most tropical countries, more especially in India, where the dark grey or yellow seeds, of the size of small peas, are a universal article of food. Dried and "split," these are largely imported into Ceylon and used in curries, vegetable soups, etc., being everywhere sold in the boutiques as "paripu." The plant resists drought well, and is recommended as a restorative crop in rotation. In India it is grown either as an intercrop or as a pure crop, being planted in rows about 5 × 4 ft.; the former takes about 5 lb. of seed to sow an acre, and the latter about 20 lb. The crop is ready for picking in about 6 months from sowing. It is in bearing almost throughout the year, but the bushes should be cut back periodically and well manured. Grown as a pure crop, the average yield may be about 800 lb. seed or more per acre, or 200 lb. as a mixed crop. Not generally grown commercially in Ceylon. A variety recently introduced from India has large pods, 4–5 in. long, with comparatively large, yellow seeds. The plant is cultivated in India for the production of Lac (*q.v.*).

Canavalia ensiformis. Sword-, Jack-, or Horse-bean; Awara, *S*; Awara-kai, *T*. A robust, woody, perennial, climbing bean, bearing large, coarse, rather flat, sword-shaped pods, 10–12 in. long by about 1½ in. broad, containing large, white seeds, of which about 300 = 1 lb. In the young and tender state the pods may be sliced, boiled, and used as a vegetable. The young and tender seeds may be peeled and used as broad-beans. The plant requires strong and durable supports, such as a fence or a low spreading tree.

C. ensiformis var. nana. Gotani-bean of E. Africa. A bush variety, 2 ft. high, bearing pods similar to those of the climbing form. Seeds may be sown in



SWORD BEAN (*Canavalia ensiformis*). DWARF LIMA BEAN (*Phaseolus lunatus var.*).

rows, $2\frac{1}{2} \times 2\frac{1}{2}$ ft., say at the rate of about 25 lb. to the acre. A crop is produced in 3–4 months, yielding from 12 to 16 bushels (700–900 lb.) of seed per acre.

Cicer arietinum. Chick Pea; Bengal Gram; Konda-kadala, *S*. An annual, about 1 ft. high, much cultivated in India as a food-crop. The small, pea-like, angular seeds are largely imported into Ceylon and sold in the boutiques, being used either fried and roasted, or boiled in curries, and are considered very nutritious. Roasted and ground, they are sometimes used as a substitute for coffee. The crop is sown broadcast or in drills, the former at the rate of about 30 lb. to the acre. A yield of 400–500 lb. per acre is usually obtained. A bushel of seeds weighs 60 lb., and about 3,000 seeds = 1 lb. The straw contains oxalic acid, and is therefore considered unsuitable for fodder.

Cyamopsis psoralioides. Guar- or Cluster-bean; Kotaranga, *S* or *T*. A bushy perennial, 2–4 ft. high, commonly cultivated in India and sometimes in Ceylon and elsewhere as a food-crop. The small, straight, radiating, hairy pods, 3–4 in. long, produced in clusters, are used as a curry vegetable, but are rather fibrous and must be used in a young state. The ripe seeds, which are black, white, or grey, are also eaten. Some varieties are cultivated for fodder or for green manuring. (See *Food Analyses*.)

Cluster Bean (*Cyamopsis psoralioides*).

Dolichos bracteata. El-dhambala, *S*. A climbing bean, bearing purplish flowers and narrow, well-filled pods, about 3 in. long, which when young and tender are boiled and eaten.

D. Lablab, var. Bonavist-bean; Ho-dhambala or Irivija, *S*; Motchai, *T*. A strong-growing climbing bean, producing flat, broad pods with warted or wavy margins, 4–5 in. long, which when young and tender are boiled and used as a curry vegetable, as are also the immature seeds. The plant is often cultivated in coolie gardens in Ceylon. It occurs in several varieties with white, pink, or purplish flowers and white or reddish seeds. "Sudu-dhambala" has white flowers and short, broad pods, containing 2–3 white seeds each. A bush form, about 2–3 ft. high, is best suited for cultivation. The yield may be about 400 lb. per acre, the seed-rate for which is about 30 lb. 1600 seeds = 1 lb. (See *Food Analyses*.)

D. biflorus. Madras-gram; Horse-gram; Kollu, *S* and *T*. A semi-erect annual, about 2–3 ft. high, with small trifoliate leaves, bearing narrow, curved pods, 2–3 in. long. It is grown somewhat extensively in India, either as a food or fodder crop, or as a green-manure for ploughing into the soil. The plant is suited to a dry climate, and is commonly grown in Ceylon in the drier districts.

Glycine hispida. Soy or Soya-bean. An erect annual about 2–3 ft. high, varying according to variety and soil, sometimes reaching 4–6 ft. or more; native of China and Japan, where it has long been cultivated both as a food-crop and stock feed. It is also commonly grown in E. Bengal, Indo-China, etc. The short, hairy pods each contain 3–4 seeds, which are a nutritious food and a standard article of diet in the home of the plant, being next in importance to rice. The smooth pea-like seeds ("beans") vary in colour, according to variety,

from brown, black, yellow and green, and are cooked and prepared for food in numerous ways, being boiled, roasted, or ground into flour.

They contain little or no starch, and are made into biscuits or bread for diabetic patients; are said to be sometimes used for adulterating coffee, and in India are prepared and eaten like "dhal." A valuable domestic oil, largely used for margarine, soap-making, etc. is obtained from them, and the residual cake forms a nutritious cattle-food. The seed is largely exported from Manchuria, chiefly for the extraction of the oil, London alone taking over a million tons annually, being quoted at present at about £12–£15 per ton.

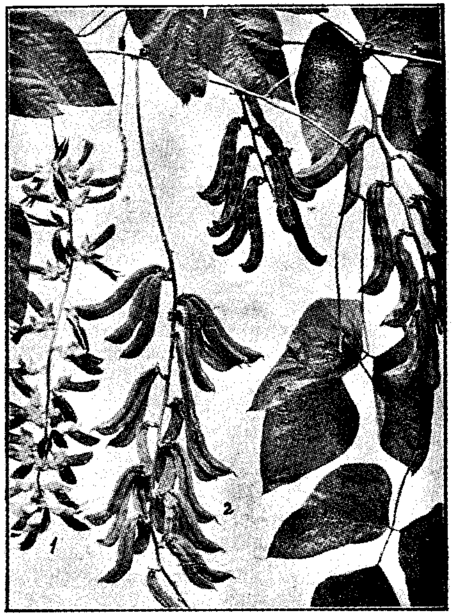
Cultivation is simple. A sub-tropical climate, moderate rainfall, rich, friable and well-tilled soil are the principal requirements of the crop. Seeds may be sown thinly in rows, about 2×1 ft., or wider according to variety, at the rate of about 20 lb. per acre. The seeds germinate rapidly, and the crop may be ready for picking in 3 months from sowing.

Yield varies according to variety, soil, climate, etc., about 20 bushels (or 1,000 lb.) seed per acre being considered a good average return. The results of experiments at Peradeniya, Ceylon, have shown that the crop is not suited for commercial cultivation in the tropics. There are numerous varieties, which vary in size of plant, colour and size of seed, etc. The yellow-seeded kinds are considered the best suited to a hot climate. Tall-growing varieties are cultivated for fodder, yielding 8–10 tons per acre. (See *Fixed Oils*.)

Soya Bean (*Glycine hispida*).

Lens esculenta (*Ervum lens*). Lentils; Misurupur, *T*. A low bushy annual, 14–18 in. high, cultivated for food from time immemorial. Lentils are to this day an important article of diet to the inhabitants of Egypt, Palestine, the Mediterranean region, etc., and are grown as a winter crop in many parts of India, more especially in the Central Provinces.

It thrives best on a clay soil, the seed being usually sown broadcast at the rate of about 30 lb. per acre. If

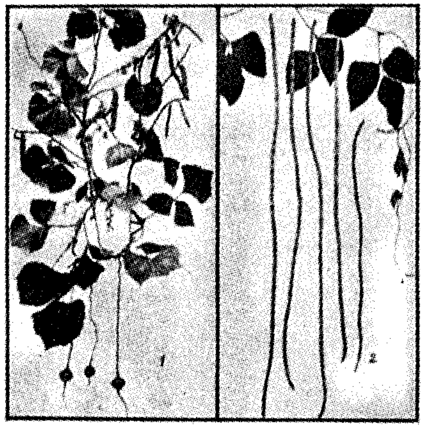


Velvet Bean (*Stizolobium deeringianum* = *Mucuna nivea* var.). (1) Flowers; (2) Pods.

sown in drills, half that quantity will suffice. The seed is eaten like "dhal," and considered one of the most nutritious of pulses. The dried leaves and stems are valued as cattle-food, and in the green state form a useful green-manure. The crop is ripe about 3 months after sowing, and the yield as a pure crop is about 6–8 maunds (of 80 lb.) per acre. The seed, whole or "split," is largely exported from India.

Mucuna (Stizolobium) nivea. Velvet-, Lyon-, Florida-, Mauritius-bean, etc. Wanduru-mé, *S.* Cultivated varieties of this or closely allied species have in recent years come into prominence, more especially as green-manure or stock-feed. They are strong-growing perennial or annual, quick-growing creepers, and yield from 8–10 tons of green matter per acre. The velvety, curved pods, 3–5 in. long, contain round seeds, dark brown or mottled, which may be cooked and eaten after removal of the outer skin. The young pods also are edible. Roxburgh (India) considered a variety of this "a most excellent vegetable, scarcely inferior to the garden beans of Europe." Seldom cultivated in Ceylon. (See *Fodder Plants.*)

Pachyrhizus tuberosus. Yam Bean; Potato Bean; Sincamas. A strong-growing, climbing bean, native of Trop. America, naturalised and cultivated in the Philippines, etc., introduced to Ceylon in 1887. It produces edible tubers and pods, the latter being about 6–8 in. long and used as a vegetable when young. It takes two years for the tubers to reach full size. The plant is commonly cultivated in its native country, but is as yet scarcely known in Ceylon. Cultivation the same as for other climbing beans. Sow seeds thinly in rows about 4 ft. apart, with 15 in. between the seeds in the row, and support the vines on poles or bamboos. There are blue- and white-flowered varieties.



(1) Yam (Tuber) Bean. (*Pachyrhizus tuberosus*). Young plant. (2) Yard-long Bean (*Vigna sesquipedalis*).

Phaseolus lunatus. Lima-, Sieva-, Tonga-, Burma-, Rangoon-, or Madagascar-bean; Pothudhambala, *S*; Pithanga, *T.* This climbing annual bean, which occurs in several varieties, is commonly cultivated in the tropics for local consumption, and in some cases for exporting the seed. It is best suited to the higher elevations, and is commonly grown in up-country gardens. The short, flat and rather curved pods are eaten in the unripe state as a green vegetable. The ripe, coloured seeds contain traces of prussic acid, from which the whites are free. The latter are therefore preferred and are largely exported from Madagascar, etc. The plants are of a robust habit, bear racemes of small, white or pink flowers and may be sown at any season. Sow in rows about 4 ft. apart, with about 12 in. between the seeds in the rows. Place strong stakes along both sides of the rows for supporting the vines.

Varieties. There are dwarf or non-creeping varieties, which are preferred by some for cultivation. The Bush Lima grows to a height of about 2 ft., is a heavy cropper and may be sown in rows about 2 ft. apart each way, about 20 lb. of seeds being required to sow an acre. Cropping begins about 6 weeks from sowing, and continues for a month to 6 weeks. Henderson's Bush Lima and Burpee's Dwarf Lima are heavy cropping vars., yielding about 1,200 lb. per acre.

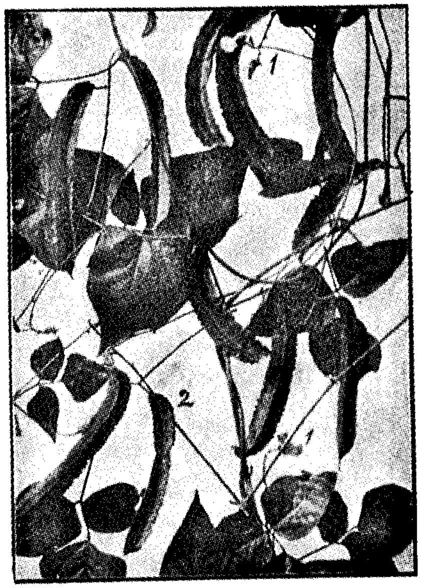
P. Mungo, var. (P. Max). Green-gram; Mung; Muneta, *S*; Pasi-pyru, *T.* A small, erect, hairy annual, about 16 in. high, with narrow, cylindrical, straight, radiating pods about 3 in. long, and trifoliate leaves; native of India, where it has

long been cultivated as a food-crop. It is also grown to some extent in the dry zone of Ceylon, either as a pure or intercrop. The young pods may be used as a vegetable, but it is the ripe seed (pulse) that is chiefly valued, this being cooked and used in various forms, like dhal. The straw is useful as fodder. Suited to dry districts; thrives in the plains of India and up to 6,000 ft. When grown alone, under average conditions, a yield of about 450 lb. of pulse per acre may be obtained. A bushel of seeds weighs about 70 lb., and 4–5 lb. are required to sow an acre.

P. Mungo, var. radiatus. Black-gram; Kalai; Urd. This differs from Green-gram in having longer stems and a more trailing habit, also in the plant being more hairy, and the seed fewer, larger, and usually dark brown in colour. According to Watt, it is the most highly esteemed of all pulses in India and commands the highest price. It is eaten either in the form of bread made from a meal, or boiled whole, or as spiced balls. It is the chief constituent of the wafer biscuits known as "papad" or "papadam." As a pure crop, the seed-rate is about 20 lb. per acre, from which the average yield is about 450–500 lb.

P. vulgaris, var. Climbing- or Runner-beans; Bonchi, *S*; Bonchi-kai, *T.* One of the most useful climbing beans for low and medium elevations. With a few successional sowings a supply of beans may be obtained throughout the year. The young tender pods are boiled and served in different ways. Sow seeds thinly in rows about 3 ft. apart, in well-tilled and manured soil. The seeds germinate in from 4 to 6 days. Earth up the plants when about 12 in. high, and fix stakes along both sides of the rows to support the vines.

Varieties. The dwarf or non-creeping varieties include the French-, Haricot-, or Kidney-bean (*q.v.*). The "Rodriguez Bean" is a dwarf variety, 12–14 in. high, which bears profusely and yields a crop in about 6 weeks to 2 months from sowing. Pods almost cylindrical, often streaked with red, 4–6 in. long.



Winged Bean (*Psophocarpus tetragonolobus*). (1) Flower buds; (2) fringed or 4-winged pods.

Psophocarpus tetragonolobus. Winged-, Goa-, Manila-, or Princess-bean; Dara-dhambala, *S.* A strong-growing climbing bean, said to be native of Mauritius, with large, pale blue (sometimes white) flowers, bearing peculiar 4-angled pods. The latter are 6–8 in. long, and have a leafy fringe running along the length of each of their four ridges. In the tender state they are sliced, cooked, and usually much relished. In Burma, where the plant is commonly cultivated, its fleshy tuberous roots are also used as an article of food and estimated to yield from $1\frac{1}{4}$ to 2 tons per acre. Sow seeds in drills 4 ft. apart, or along a fence or other support, and provide stout stakes for the vines.

Vigna Catiang (V. sinensis). Cow-, Tonkin-, Jerusalem-, Blackeye-, Catiang- or Marble-pea; Mé-karal, *S.* An annual, twining bean with trifoliate leaves, leaflets about 3–5 in. long. The young pods, 4–6 in. long when mature, are used as

French Beans, or the seeds when ripe are cooked and eaten. The yield of seed may be 500 lb. per acre; about 3,000 seeds = 1 lb. 10 lb. should sow an acre.

V. sesquipedalis. Asparagus Bean; Yard-long Bean; Diya-mékaral or Polon-mé, *S*. A twining annual, bearing long, pliant, narrow pods (2–4 ft. long by ½ in. broad), which furnish an agreeable tender vegetable. Cultivated throughout the tropics. The plant is especially suited to the low-country and medium elevations. There are many varieties, which vary in length of bean and are known by different local names.

GOURDS, PUMPKINS, SQUASHES, AND MELONS (*CUCURBITACEAE*)

These comprise a group of herbaceous climbing plants, mostly annuals, many of which yield excellent vegetables; a few yield dessert fruits (see *Melons*). The plants are generally *monoecious* (the sexes in separate flowers on the same plant), in some cases *dioecious* (the sexes on separate plants). They are of rapid growth, and generally require rich friable soil and abundant moisture at the root. As a rule they are best suited to a rather dry climate, with irrigation. The mature fruits (gourds) are often remarkable for their keeping qualities after being cut, in some cases lasting several months in a condition fit for consumption, *e.g.* Pumpkin, the dried shell of which is sometimes used for domestic utensils or ornaments. Propagation is by seed or cuttings.

White Gourd or Ash Pumpkin (*Benincasa cerifera*).

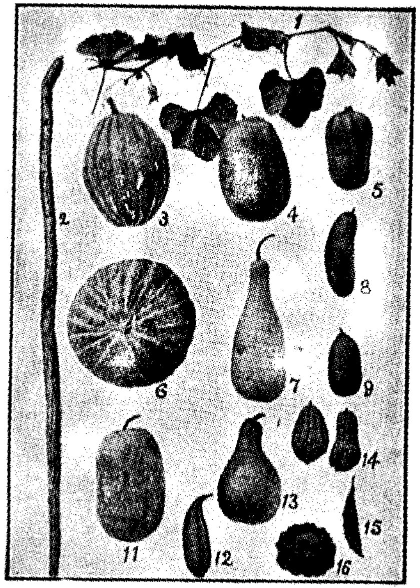
Benincasa cerifera. Ash-Pumpkin or White-Gourd; Alu-puhul, *S*; Puchchini or Pusani-kai, *T*. A large, handsome, annual vine, grown in all warm countries. The large, ovoid fruit is covered with a whitish waxen bloom (hence its popular names), and is used as a vegetable, sometimes candied as a sweetmeat. The plant, with its large angular leaves, may often be seen growing over the roofs of peasants' houses. In India, it is said, the fruit is not so liable to be stolen as those of other gourds, owing to certain religious superstitions. Seed may be sown in the rainy season, and the vegetable should be fit for use about 2 months later. The plant will thrive in sheltered valleys up to about 4,000 ft. or higher.

Cucumis sativus, var. Native Cucumber; Pipingha, *S*; Pipingkai, *T*. A thick, cylindrical, smooth fruit, 10–15 in. long and about 3 in. across, usually brownish-yellow when mature. The yellow flowers are about 2½ in. across. The fruit is either cooked and used as a vegetable or, peeled and sliced, in salads, being a good substitute for the Cucumber proper, which is considered to have originated from it.

It is cultivated chiefly in the drier districts for supplying local markets or boutiques. Sow seed in ridges or mounds of rich soil and manure. The vines may be supported on trellis-work, or allowed to trail over the ground in dry localities.

Varieties. There are several varieties, with fruit varying in size and form. "Tee-amabara" bears fruits about 6–8 in. long and about 2 in. diameter, rather tough in texture, only used as a vegetable when cooked. "Haen"- or "Kanda-kekiri" bears small, ovoid, smooth-skinned, brownish-yellow, ornamental gourds, 3–4 in. long; specially suited to dry districts, often cultivated in Ceylon as a dry-ground or chena crop.

Cucurbita maxima. Pumpkin; Wattaka or Rata-labu, *S*. A large, globular, bluntly-ribbed, brownish-yellow gourd with yellowish flesh, commonly grown throughout the tropics. The plant is an annual and suited to rather dry and hot districts, as Kurunegala, Dumbara, and Jaffna in Ceylon. The gourds keep good for a long period if stored in a dry airy room. They are commonly sold in local markets and boutiques, either whole or in portions. Though watery and rather insipid, it is considered one of the best of tropical vegetables, being easily cultivated and giving quick and heavy returns.



Collection of Gourds.
2, Snake-gourd, *Tricosanthes anguina*. 3, Polong-wattaka, *Cucurbita moschata*. 4, Water-melon, *Citrullus vulgaris*. 5, Vegetable-marrow, *Cucurbita Pepo*. 6, Pumpkin, *Cucurbita maxima*. 7 and 13, Bottle-gourd, *Lagenaria vulgaris*. 8, Native cucumber, *Cucumis sativus var.* 9, Tee-amabara, *Cucumis sativus var.* 11, Ash Pumpkin, *Benincasa cerifera*. 12, Loofah, *Luffa aegyptiaca*. 14, Cho-cho, *Sechium edule*. 15, Carilla-fruit, *Momordica Charantia*. 16, Squash, *Cucurbita Melo-pepo*.

Seed may be sown at any time during the rains, in deep holes filled with rich soil and manure, the vines being allowed to run over the ground without supports. The fruits sometimes grow to a great size, instances being recorded of specimens attaining from 200 to 300 lb. or more in weight and 7 to 8 ft. in circumference. The shell when dried becomes very hard, and is often made into light and durable vessels for carrying purposes. There are many varieties, which vary in size, form, and colour of fruit.

C. Melo-pepo. Squash. The name Squash is given in America to numerous varieties of gourd which bear variously-shaped fruits, these ranging from ovoid to almost flat or shell-like forms. Squashes are extensively grown in the warmer parts of the U. States, where they are much appreciated as a vegetable, but do not appear to be suited to a wet tropical climate. In the drier districts, however, at medium or high elevations, they thrive and bear moderately well.

Sow seeds in boxes, and transplant the seedlings, when large enough to handle, into mounds of well-prepared earth. The plants may be left to trail over the ground like pumpkins. During wet weather a piece of flat stone or tile should be placed under each fruit to prevent it from rotting. Squashes are boiled green, like vegetable-marrow, or mashed like turnips and served with milk, pepper and salt. When

ripe, they may be made into pies, etc. In France they are sometimes gathered when of the size of an egg, boiled, flavoured, and served on toast.

C. moschata. Polong-wattaka, *S.* A large, ovoid or round gourd, with yellow spots and dark-green patches or streaks. Cultivation, etc., the same as for Pumpkin.

C. Pepo. Vegetable Marrow, see *Up-country Vegetables.*

Lagenaria vulgaris. Bottle Gourd; Diya-labu, *S*; Sorakai, *T*. One of the most popular of native vegetables, commonly cultivated in the tropics, suited chiefly to semi-dry districts, as Kurunegala and Dumbara in Ceylon. The fruit varies in length from 16 to 24 in. or more and is variously shaped, often resembling a large decanter or water-bottle. The unripe fruits when boiled are a wholesome though rather insipid vegetable. When ripe and seasoned, the shell becomes very hard and durable and, being emptied of the pulp, is commonly made into vessels used for carrying water or collecting palm-toddy, etc. The plant is an annual herbaceous vine, usually with white flowers about $2\frac{1}{2}$ in. across, and is best supported on trellises or against trees.

SNAKE GOURD (*Tricosanthes anguina*). Showing Gourd fruits 4–6 ft. long.

Luffa acutangula. Veta-kola or Dara-vetakola, *S*; Pekan-kai, or Pey-pichukku, *T*. A distinct annual climbing vine, bearing gourds 8–10 in. long with prominent sharp ridges. These are commonly used in a tender state as a curry-vegetable, the outer part being peeled off before cooking. The plant is commonly grown in the tropics, being raised from seed and supported on trellis-work or low-branching trees.

L. aegyptiaca. Loofah; Sponge-gourd; Niyan-vetakola, *S*; Pikku or Pichukku, *T*. A large, annual, climbing gourd with angular stems, indigenous to Trop. Asia, commonly grown in warm countries. The cylindrical fruit is from 8 to 14 in. long, and is used when tender as a vegetable. (See *Fibres.*)

Momordica Charantia. Carilla Fruit; Karawila, *S*; Pakal or Pavakai, *T*. A rather slender vine, bearing an ovoid warty gourd, 6–8 in. long, bright orange-yellow when ripe; commonly cultivated in the tropics as a vegetable or for ornament. The bitter fruit is adapted for pickling, being one of the most common ingredients in Indian pickles. There are several varieties, one of which has white fruits.

M. dioica. Tumba-karawila, *S*; Tumpai or Palupakkai, *T*. A small, oblong, green, warty-looking gourd, 2–3 in. long, commonly used and much esteemed by the peasants as a curry-vegetable. The tender shoots and leaves also are edible. A native of Trop. Asia, it is common in the drier districts of Ceylon. Sow seeds during the rains, and provide supports by means of bamboo poles for the vines.

Sicana odorifera. Melocoton; Casabanana. A perennial climbing vine, native of Trop. America, bearing stout cucumber-like fruits, 10–15 in. long and about 3 in. diameter. In the green and unripe state these afford an excellent vegetable, and when ripe are suitable for preserves. On approaching maturity the fruit assumes a brownish-red colour and a pleasant fragrance. The plant is a rapid grower and attains a length of about 50 ft.; thrives in rich soil in a sunny position, and should be allowed to ramble over an arbour or trellis. Suited to a rather dry climate.

Trichosanthes anguina. Snake-gourd; Club-gourd; Patola, *S*; Podivilangu or Podalangai, *T*. A quick-growing annual gourd, native of China and Malaya, commonly cultivated in the tropics. It bears long, cylindrical, green or greenish-white fruits, 4–6 ft. in length. In an unripe state these are sliced and cooked, being commonly used and much relished as a curry-vegetable. Seeds are sown at the beginning of the rains, against a trellis-work of bamboos or other supports. A crop should be obtained in 3 months from planting. It is customary to tie a small stone to the end of each fruit while growing, so as to weight the latter down and induce straight growth.

ROOT- OR TUBEROUS-VEGETABLES AND FOOD-CROPS

Calathea Allouya. *Scitamineae.* Leren; Topee-tambu (Topinambour). A herbaceous perennial, about 2 ft. high, with large, oval, Canna-like leaves, native of Trop. America and parts of the W. Indies, common in Grenada, etc., introduced to Ceylon in 1893. It produces numerous fibrous tubers which resemble small potatoes and, though of poor quality as a vegetable, are relished in the plant's native country and sometimes cultivated. The tubers are of a hard, somewhat gritty nature, require a considerable amount of boiling, and have but little flavour. Those who have acquired a taste for them, however, pronounce them delicious. They are said to be sold in the streets of some of the larger towns of S. America, "ranking with ground-nuts in popularity." The plant is grown at Peradeniya, Ceylon, but the tubers are not eaten. Propagated by suckers or offshoots (the tubers have no "eyes" or buds), and planted about $2 \times 1\frac{1}{2}$ ft. About 10 months are required to produce a crop, and the yield is said to be as much as 4 tons per acre.

TOPEE-TAMBU (*Calathea Allouya*). Showing potato-like tubers.

Canna edulis. *Scitamineae.* Purple Arrowroot; Adeira (Peru); Tous-les-mois; But-sarana, *S*; Vailay-sembu, *T*. A handsome herb. perennial, with red fls. and large, bronzy lvs., 3–5 ft. in height, considered to be a native of the W. Indies; commonly grown in peasants' gardens in Ceylon, more especially by Tamils. The starchy, purplish, tuberous rhizomes, 8–10 of which are usually produced by each plant, are either cooked and eaten as a vegetable, or made into flour and used as arrowroot. The plant is sometimes cultivated commercially in Queensland, furnishing the "Queensland arrowroot." The yield, under favourable conditions, is estimated at from 5 to 8 tons of tubers per acre, giving about $1-1\frac{1}{2}$ tons of prepared arrowroot. The latter, which may also be used as starch, is valued at about 6*d.* per lb. The plant is propagated and cultivated in the same way as the ordinary Arrowroot, the rhizomes

being planted in rows about 3 × 2 ft. The crop takes from 6 to 8 months from planting to come to maturity. Cultivated in Rhodesia as stock feed.

Colocasia Antiquorum (C. esculenta). *Aroideae.* A herbaceous tuberous perennial, with large handsome leaves, long cultivated in tropical countries and occurring under numerous names. These vary in different countries, as Coco-yam, Eddo, Dasheen, etc. (W. Indies); Taro, Gabi, Colalu, etc. (Trop. America and Pacific Islands); Melanga (Cuba); Talla (Malaya); Kachchi, Kachu, Arvi, etc. (India); Qulqas (Egypt); Kiri-ala, Daesi-ala, Kand-ala, Sevel-ala, Gahala, etc. (Ceylon). There are two distinct forms (or genera), one of which is characterised by peltate lvs. (petiole joined at a point towards centre of leaf), the other by hastate or sagittate lvs. (arrow-shaped), with the petiole joined at the leaf-base, as in ordinary lvs. The latter form is usually placed under the genus *Xanthosoma,* which includes Tannia or Tanier, Yautia, Habarala, etc.

Coco-Yam, Tannia, or Taro, etc.
(1) *Alocasia* (*Xanthosoma*) *indica* var., with sagittate leaves,—" Habarala."
(2) *Colocasia Antiquorum* var., with peltate leaves,—" Eddo " or " Kiri-ala."

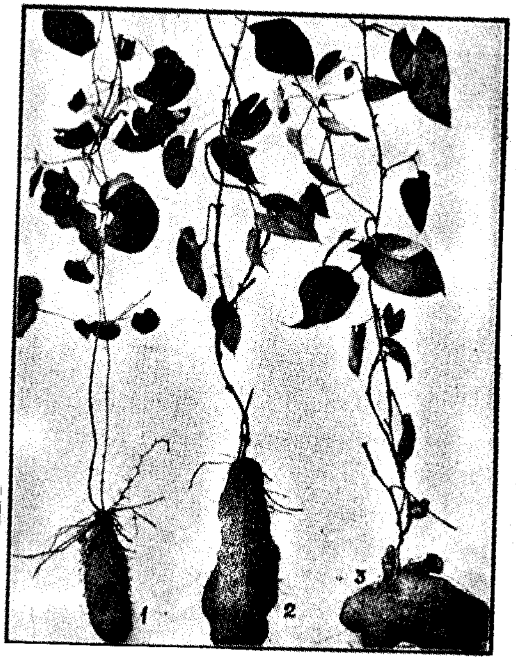
The underground tubers vary in size from that of a small to a medium-sized potato, usually with a fibrous skin. Some varieties, however, produce few tubers or none, being grown for the tender leaves and shoots only, which are cooked and used as a vegetable. In other varieties, as Daesi-ala of Ceylon and Dasheen of Trinidad, both tubers and tender leaves are eaten. Most varieties are more or less characterised by an acrid property, which, however, is removed by boiling and cooking. The tubers are a nutritious article of food, resembling artichokes, to which they are considered to be equal or even superior, being preferred by some even to potatoes. They may be cooked and served in different ways, some (*e.g.* Eddo, Dasheen, and Kand-ala) make delicious soup, and are used as a delicacy for invalids. Though a popular vegetable in the W. Indies,* etc., they are not commonly consumed in the East except by the poorer people, to whom they are a regular stand-by. They are, however, much cultivated in Egypt, Hawaii and Trop. America.

The plants thrive in moist and well-manured soil, preferring low-lying ground, as near swamps and streams, though some are adapted also to drier ground. In dry regions they do well under irrigation. Tubers may be planted in rows, 3 × 3 ft. or 2½ × 2 ft., according to variety and locality. Certain varieties, as Thun-mas-ala (= 3-months yam), yield edible tubers in 3 months from planting, most varieties taking 6–8 months, some 9 months or more. The yield under favourable condition is variously estimated at from 3 to 5 tons or more per acre.

* Bull. of Dept. of Agric., Trinidad and Tobago, Parts 2 (1916) and 1 (1918).

Varieties. Numerous varieties, as already stated, are recognised, over 200 occurring in Hawaii alone. The principal varieties in Ceylon are: Kiri-ala or Sudu-kandala (leaves and stalks very pale green), Yakutala, Gahala, Kalu-kandala (leaf-stalks purplish-green), Gerandi-kandala (leaf-stalks mottled), Thun-mas-ala, Daesi-ala, Habarala (leaves hastate), etc. Mock-tannia is said to be one of the best and most prolific varieties in Trinidad.

Cyperus esculentus. *Cyperaceae.* Chufa; Ground-almond; Tiger-nuts. A small perennial grass-like sedge, indigenous to W. Asia and various parts of Africa. Its small underground tubers are edible, having a nutty flavour, and may be cooked and used as a vegetable. These, when dry, look like large wrinkled peas. Roasted and ground, they are sometimes used for adulterating coffee. They also yield an oil used for culinary purposes. The plant is commonly cultivated by the natives of the Gold Coast, chiefly along the sea-board, the tubers, which " are not at all unpleasant to eat, being sold in the local markets." The plant thrives in almost any dry sandy soil, yielding a crop of 800 lb. or more per acre in 4–6 months. This species does not appear to spread or become a troublesome weed, like *C. rotundus.* (See *Weeds.*)



Dioscorea Yams in Ceylon.
(1) Java-ala, *S*; Natu-kelengu, *T*.
(2) Jaffna Yam or Kiri-kondol, *S*.
(3) Rata-kondol, *S*.

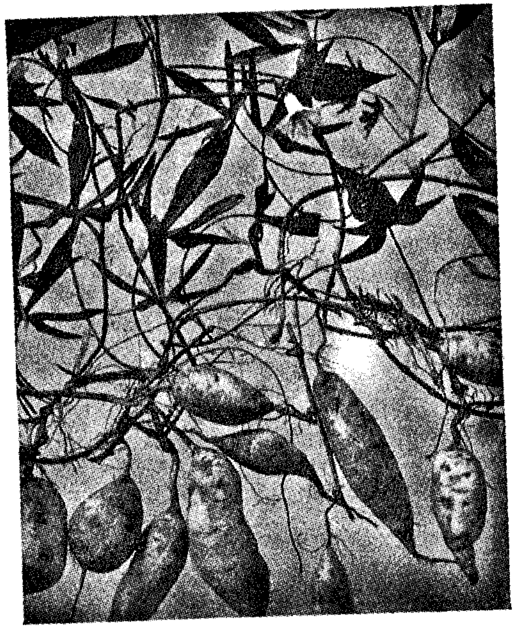
Dioscorea. Yams; Vel-ala, *S*; Kodi-kelengu, *T*. *Dioscoraceae.* Different species and varieties of Dioscorea constitute the true Yams, which are herbaceous twiners (twining clockwise), with or without prickles, often with winged or angled stems, large, oval 3–6 nerved leaves and large, underground edible tubers, often with hair-like or prickly rootlets. In Ceylon, " yam " (" ala ") is a common term for any tuberous plant. The Dioscorea yams are largely cultivated in the W. Indies and Trop. America, where they form a standard article of diet with all classes, the best being sometimes preferred even to good potatoes. In Ceylon and the Eastern Tropics, however, they have not as yet gained such popularity, and though often met with in peasants' gardens and sometimes sold in markets, they are not a common commodity.

Cultivation.—Yams are easily cultivated and thrive best in deep loamy soil, up to an elevation of about 3,000 ft. They may be planted in mounds, or against fences, trees, etc., or in rows about 4 × 3 ft. The best time for planting in Ceylon is February–March, when the plants are dormant. The ground should be dug to a depth of at least 2 ft. and well manured. Pieces of the crown or yam-head, about ¼ lb. each with 2 or 3 " eyes," are used as setts for planting. Cuttings will sometimes strike root if taken from mature portions of the stems. Poles or stout

bamboo tops should be fixed in the ground along the rows for support to the vines; or 3 poles may be arranged round the plant in tripod fashion.

Yield. The crop is ready for harvesting in about 9–10 months from planting, the leaves then becoming spotted brown and the stems dying down to the ground. The yield may be at the rate of from 5 to 6 tons or more per acre, according to variety, soil, and locality. The tubers may be lifted and stored in a cool shed, under dry earth or sand; or they may be left in the ground and used as required, provided they can be protected from vermin and other enemies. Yams can be cooked and prepared for food in various ways, being roasted, baked, or boiled and steamed, etc.

Varieties. There are numerous species or varieties, some half-dozen species being indigenous to the moist low-country jungle of Ceylon. Many of the cultivated forms differ in colour and shape of tuber, as well as in foliage, etc. A large number of these probably belong to the species *D. alata.* Local or vernacular names are numerous and confusing; the following include the principal varieties known in Ceylon.



SWEET POTATO (*Ipomoea Batatas*).

Stem 3 to 5-winged or -angled, tuberiferous, without prickles; leaves opposite, entire: Angili-ala (Verraelvalli-kelengu, *T*); Bindhar-, Ingur-, Japana-ala; Kaharata-ala (Karavalli-kelengu, *T*); Kiri-kondol (Artuvalli-kelengu, *T*); White-yam or Kirivel-ala; Raja-ala or Rata-kondol. *D. alata.*

Stem round, lvs. alternate: Uda-ala (Kodi-kelengu, *T*). *D. bulbifera.*

Stem round or slightly grooved, tuberiferous, with prickles, lvs. alternate or opposite, entire: Hiri-tala (Sheenivalli-kelengu, *T*). *D. obcuneata.*

Java- or Natt-ala; Katu-kukul-ala and Kukul-ala. *D. fasciculata.* Jambur-ala; Kaha-ala or Guinea-yam. *D. aculeata.*

Lvs. 3 to 5-digitate: Katu-ala (Mulluvalli-kelengu, *T*). *D. pentaphylla.*

Stem round, without prickles or tubers, lvs. opposite: Gon-ala. *D. spicata.*

Inedible Ceylon yams: Uyala (*D. tomentosa*); Panu-kondol (*D. sativa*); and *D. intermedia.*

Yampee or Cush-cush (*D. trifida*), Yellow-yam (*D. cayensis*) and Negro-yam (*D. rotundata*) are favourites in the W. Indies; the last-named is also commonly grown in W. Africa. "Lisbon" is a prolific bearer in Trinidad. "Niame-chino" and "Niame-pellu" are well-known Cuban varieties.

Ipomoea Batatas. *Convolvulaceae.* Sweet Potato; **Ba-tala,** *S*; Vel-kelengu, *T*. A creeping or trailing perennial, producing succulent, tuberous roots, which are a tasty and nutritious article of food, being preferred by some to the common Potato. It is considered to be indigenous to the tropics generally, though the specific name denotes S. American origin, and is cultivated in all warm countries. In the tropics it may be cultivated successfully at moderate elevations and up to 5,000 ft. or higher, provided the rainfall is not excessive. A rather dry climate, with irrigation, suits the crop, which thrives in any ordinarily good soil of a light texture.

Cultivation. The ground should be well tilled, formed into ridges about 2½ ft. apart, or banked up into beds 3 ft. wide, and manured; cuttings about 12 in. long are planted at distances of about 1 ft. or 2 × 1 ft., preferably during moist or cloudy weather; otherwise watering and temporary shading are necessary. During dry weather, the plants should be watered or irrigated. The crop should be available in about 4–5 months from planting, the leaves turning yellow when the tubers are mature. A yield of about 4–5 tons or more tubers per acre may be expected under favourable conditions. The tubers contain a good deal of starch and saccharine matter, and yield a high percentage of alcohol.

Varieties. The following are among the best varieties introduced to Ceylon: Boniata, Sierra-morena, Boniato-Amarillo, Virginia, Jersey, and Nancimund. Numerous varieties are recognised in the W. Indies and S. America, such as Blue-belle, Red Bourbon, Barbados-barrel, Blanca Mamey, White Gilkes, and Prince Henry. (See *Recipes.*)

Manihot utilissima (*Euphorbiaceae*). Tapioca; Cassava; Mandiocca; Manyokka, *S*. A shrubby perennial, 6–7 ft. high, with erect clean stems, palmately divided leaves on long stalks, and large, fleshy tuberous roots, cultivated in all tropical countries. It is a native of Trop. America, where the roots have been an important source of food from early times. Its introduction to the East is said to have been effected by the Portuguese in the seventeenth century. Two distinct kinds of Cassava are recognised, viz. "Bitter" and "Sweet" (*Manihot utilissima* and *M. palmata* (or *Aipi*) respectively), and of these there are many varieties. All are more or less characterised by the presence of hydrocyanic or prussic acid in the juice of the roots. The "Bitter" type, which contains a higher percentage of the poison, is the one chiefly grown as a vegetable, while the "Sweet" is used mostly as a source of starch.

CASSAVA OR TAPIOCA (*Manihot utilissima*).

When grated and washed, boiled or roasted, or made into a coarse meal and bread, the poison is dissipated. The starch (farina), obtained from the roots by grating, is thoroughly washed, pressed through fine meshes and heated to form the granulated tapioca of commerce. This has long been an article of export from Brazil, and more recently from Malaya, where the crop is cultivated chiefly by Chinese. Here the roots are washed, sliced and roasted to form "gaplek." Cassareep, a powerful antiseptic, capable of preserving meat, etc., is a by-product obtained by boiling down the poisonous juice of the Bitter Cassava; it is the basis of well-known sauces, including the famous "Pepper-pot" of the W. Indies. It is said that the natives of Guiana take red chillies steeped in rum as an antidote to Cassava poisoning.

Cultivation. Cassava is often cultivated as food for stock, being especially valuable for fattening pigs. It is an exhausting crop, and cannot usually be grown profitably for more than three successive years in the same ground. It is sometimes grown in Malaya as a catch-crop, as in young rubber or coconut plantations. The plant resists drought well, is suited to elevations up to about 2,500 ft., thriving in deep, rich and friable soil. Deep tillage is essential. Propagation is by cuttings

(10–12 in. long) of the stems, these being planted about 4 × 3 ft. apart, in rows. The tubers are ready for harvesting in from 9 to 12 months from planting, according to locality and variety, some varieties taking longer than others to mature.

Yield. An average yield is from 6 to 8 tons of tubers per acre, according to variety and soil; as much as 12 tons or more may be obtained from new or well-manured ground, while on poorer soils it may not be more than 3 or 4 tons. The yield of prepared tapioca also varies from about 1,400 to 2,000 lb. or more per acre, or about 25–30% of the weight of roots. Some 5,000 tons of tapioca are imported annually into England, and the price varies from 25*s*. to 30*s*. per cwt.

Varieties. A number are recognised and given local names in different countries. They differ in foliage, size and colour of tubers, character of stems, etc. Sin-yokka and Maha-sinyokka are well known in Ceylon. A variety with very curly leaves is known here as "Kaffir Cassava."

Manna or **Alhagi.** The food of the Israelites in the wilderness, obtained chiefly from *Alhagi maurorum*, a desert leguminous shrub of Arabia, Syria, etc. It is collected in the form of a sugary powder by shaking the twigs over a cloth. A similar substance is obtained from *Tamarisk articulata*, being produced on the twigs by puncturing insects. (See also *Manna of commerce.*)

Maranta arundinacea. *Scitamineae.* W. Indian- or Bermuda-arrowroot; Araluk or Hulankiriya, *S.* A low herbaceous plant, with large leaves, native of Trop. America. The name "arrowroot" is probably derived from the pointed, tapering root-like tubers. The plant is cultivated in most tropical countries for its white, starchy, underground tubers (rhizomes), which are either used as a vegetable or, by a process of grating, washing, sifting and heating, made into flour, the arrowroot of commerce. This is obtained chiefly from the W. Indies, notably Bermuda and St. Vincent, where the plant is systematically cultivated.

PURPLE ARROWROOT (*Canna edulis*).

BERMUDA ARROWROOT (*Maranta arundinacea*).

Cultivation. The plant is propagated by the tubers (rhizomes) or by suckers, and planted 6 in. deep, in furrows about 2½ × 1¼ ft., at the commencement of the rainy season. It requires deep, friable soil, wet or clayey land being unsuitable. The crop is an exhausting one, and the richer the soil the better. The plant thrives from sea-level to about 3,000 ft. in a moist, hot climate. Shade is not essential, though in light soils and exposed localities a light checkered shade is beneficial. The flowers should be removed from the plants as they appear. The tubers are usually ready for harvesting in from 10 to 11 months from planting, their mature condition being indicated by the leaves flagging and dying down. Under favourable conditions an acre yields about 4–6 tons of tubers, which should produce about 12% dry arrowroot, or say 12 to 15 cwt. "Finest W. Indian" arrowroot is usually quoted at about 2*s*. per lb. in London. See *Canna edulis.*

Oxalis crenata. *Oxalidaceae.* Oka. A small Peruvian plant, allied to the common Oxalis weed (*q.v.*), producing numerous small tubers, which sometimes grow to the size of small filberts, cultivated in Peru, where the tubers are eaten and relished, being boiled and flavoured with pepper and salt. The acid succulent leaf-stalks are also used in salads.

Plectranthus tuberosus. *Labiatae,* Coleus family. Country-potato; Innala or Ratala, *S.* A small herbaceous plant with succulent, strongly aromatic leaves, native of S. India, Java, etc., commonly grown in Ceylon and elsewhere by peasants for the small, watery but edible tubers. These are often retailed in the markets and boutiques for use as a vegetable in curries, while the leaves are used in medicine. The tubers, however, have little to recommend them as an article of food, but their quality might possibly be improved by cultivation. This and other species are cultivated in Africa, Madagascar, Indo-China, etc. Readily propagated by cuttings or tubers, which may be planted about 8 in. apart in a bed of light rich soil.

Tacca pinnatifida. *Taccaceae.* Indian Arrowroot; Gerandi-kidaran, *S*; "Lukeh" of Malaya. A stemless, perennial tuberous herb with leaves 2–3 ft. long, each parted into 3 segments, native of the drier districts of Ceylon (Bintenna, Batticaloa and Jaffna), being found in open, grassy places. It is indigenous to the Eastern Tropics generally, and is commonly cultivated in Travancore and other parts of India, Trop. Africa, Fiji, Hawaii, etc., for its large, round, tuberous rootstock. The latter yields a considerable quantity of white nutritious fecula, considered to be equal to arrowroot and relished as an article of food. The tubers, dug up after the leaves have died down, are put through a process of rasping, macerating, and washing in cold water for 4 or 5 days; the fecula then separates, and is prepared in the same manner as sago. In the crude state it is intensely bitter and acrid, but these qualities are removed by the above process. The plant is suited to a rich, porous soil, propagated by division of the rootstock, and may be planted at distances of 2½ × 1½ ft., in rows.

MISCELLANEOUS VEGETABLES AND FOOD-CROPS

Amarantus oleraceus. *Amarantaceae.* Tampala, *S.* There are several cultivated varieties of this and other species, producing brown or yellow, very small, smooth seeds, commonly used for food by the peasants. They are quick-growing annuals, varying in height from 3 to 6 ft. or more, and commonly met with in the tropics, either cultivated or as weeds. The tender leaves and shoots are boiled and used in curries or as a substitute for spinach. Some varieties, as Lansi-tampala, are cultivated for the seed only, which is made into flour. Others are grown for ornament on account of their brightly coloured foliage. They are readily raised from seed, and thrive in any ordinary soil. Sow in rows, 2 × 2 ft. for leaves, or 3 × 2 ft. for seed. (See *Dry Grains,* etc.)

Arachis hypogaea. *Leguminosae.* Ground-nut; Earth-nut; Monkey-nut; Pea-nut; Pinder; Goober; Rata-kaju, *S*; Nella-kadalai, *T.* A small, annual, trailing plant, native of Brazil, cultivated in most tropical countries. It is remarkable for its habit of burying its seed-pods in the ground to ripen, hence the name "ground-nut." Its cultivation for local trade or export forms an important industry in W. and E. Africa, S. India, Burma, the warmer parts of America, W. Indies and elsewhere. Marseilles, the chief centre of the trade in Europe, takes 200,000 tons a year.

Ground-nuts have been tried in Ceylon as an intercrop with permanent products, as with rubber and coconuts, but have not proved a commercial success, owing partly to depredations by rats and other vermin. The plant is, however, sometimes grown in gardens in the low-country.

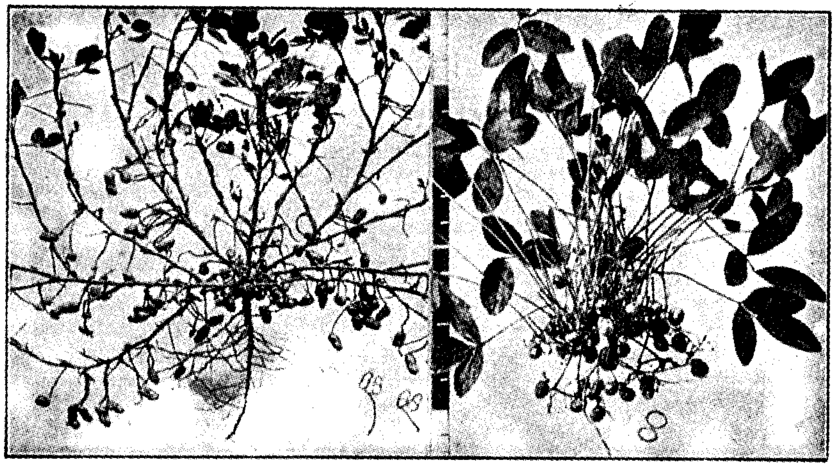
The nuts (seeds) are, especially in countries where grown, an important article of food, being used in various ways, as in soups, curries, confectionery, or roasted and eaten as dessert. In the W. Indies "they often fetch from 3*d.* to 4*d.* per lb. unshelled." They contain as much as 45% of oil, the finest grades of which are used in salad oils and margarine, but the chief use is for toilet soaps, etc. After the expression of oil from the nuts, the residue (ground-nut cake) forms a valuable cattle-food or manure, of which some 35,000 tons is imported annually to Ceylon. (See *Oils.*)

Cultivation and yield. Light, friable, well-tilled soil suits the plant best, the presence of lime being beneficial. A wet climate is unfavourable to the crop. The seed, after being shelled, may be sown 2 or 3 together, about 3 in. deep, in rows about 2 or 2½ ft. apart, with about 9 in. between the seeds in the row. Just before the commencement of the rainy season is the best time to sow. About 50 lb. (or 1 bushel) of seeds should be sufficient to sow an acre. From about 4 to 5 months, according to variety and soil, are required to produce a crop. When ripe, the plants are dug up and the nuts picked by hand. The yield per acre may vary from 1,200 lb. to about 1,500 lb. of unshelled "nuts," though with good cultivation larger yields have been recorded. There are numerous varieties, these being distinguished by yield, foliage, habit of growth, etc. "Spanish Bunch," "Virginia" and "Mauritius" are among the best. (See Bambarra-groundnuts (*Voandzeia*), also *Kerstingiella.*)

Basella alba. *Chenopodiaceae.* Country Spinach; Niviti, *S*; Pasali, *T.* A slender, herbaceous, twining annual, with succulent, circular or cordate, edible leaves, which furnish an excellent substitute for spinach. It is commonly cultivated, easily propagated by cuttings or seed, and thrives best in rich or well-manured soil. Sow or plant in rows, and afford stakes for support.

B. rubra has red stems and is similarly cultivated, but the green form above described is generally preferred. See *Talinum*, etc., p. 229.

Boussingaultia baselloides. *Chenopodiaceae.* Ala-niviti, *S.* A small herbaceous creeper of Trop. America, producing an edible tuber. The leaves also are sometimes used as spinach. Occasionally grown in low-country gardens of Ceylon.



GROUND- OR MONKEY-NUT (*Arachis hypogaea*).   BAMBARRA GROUND-NUT (*Voandzeia subterranea*).

Capsicum grossum (C. frutescens). *Solanaceae.* Capsicum; Chilli- or Bell-pepper; Malu-miris, *S*; Karri-kochika, *T.* Small, annual, bushy plants, of which numerous varieties are cultivated. Though related to the smaller pungent kinds of pepper-chillies (see *Spices*), they are distinguished from them by the large, quite pungentless, hollow, succulent fruits. These are round or oblong, much wrinkled, 3–5 in. diameter, varying from deep green to orange, bright red, amber, etc., and are much relished when boiled and used as a vegetable, or served raw in salads. The plants thrive best in loose, rich, friable soil, under light shade, and are suited to medium and high elevations, provided the rainfall is not excessive. They are largely cultivated in S. Europe and elsewhere.

Cordeauxia edulis. *Leguminosae.* Yeheb-nut. A small, slow-growing, shrubby desert tree of Somaliland. It begins to bear small, 1-seeded pods when only 3–4 ft. high, and continues bearing as it develops into a tree. The seeds (nuts) are about the size of a bean (*Phaseolus*) and are commonly used locally as an article of food.

Edible birds' nests. Though only partly a vegetable product, edible birds' nests rank as an important article of table delicacy in China, where they are made into a celebrated soup. These consist largely of vegetable matter and are formed by species of swifts (*Collocalia*) inhabiting caves. Their chief nutritive value is derived from the dried salivary secretion with which the birds line the nests. Young white nests are the most highly prized and are sold at from £40 per thousand, "the best quality commanding their weight in silver." The annual import into Canton alone is said to amount to about 9,000,000 nests. Edible birds' nests have until recently been exported from Ceylon to China, some 10 cwt. valued at Rs. 3,016 having been exported in 1923. They were collected, under Government licence, from caves, chiefly in the Southern Province.

OKRA (*Hibiscus esculentus*).
(1) Flower bud; (2) open flower; (3) fruit.

Hibiscus esculentus. *Malvaceae.* Okra or Ochro; Gobba; Gumbo; Bamia (Arabic); Lady's Fingers; Bandakka, *S*; Bandak-kai, *T.* An erect annual of the "Shoe-flower" family, 4–6 ft. high, bearing large roundish or palmate leaves and erect horn-like pods, 5–8 in. long. When young these are an agreeable mucilaginous vegetable, much relished by some when boiled and served in salads or in soups, etc. As the pods approach maturity, they become fibrous and inedible. The plant is grown throughout the tropics, and occurs in several varieties. It is not suited to high elevations, but may be grown as a summer crop in warm or sub-tropical countries.

Sow seeds at the commencement of the rains, in rows 3 ft. apart, subsequently thinning out the plants to distances of about 18 in. in the row. Or sow in a bed and afterwards transplant the seedlings into well-prepared and manured soil. The dwarfer varieties may be planted 24 × 15 in. A crop is obtained in from 2½ months onwards. The plant does best in rich and well-manured soil.

Ipomoea aquatica. *Convolvulaceae.* Kan-kun, *S.* A small semi-aquatic creeper, often cultivated in peasants' gardens. The leaves and young stems are often used as a curry-vegetable. Thrives best in a shallow trench where moisture can be retained. Propagated by cuttings.

I. Bona-nox. Moon Flower; Al-anga, *S*; Al-angai, *T.* A perennial climber with very large, pure white flowers, which open late in the evening and close early the following morning; the fleshy calyces are often used as a vegetable for curries, soups, etc. Sometimes cultivated in small gardens, chiefly by Tamils. Easily propagated by cuttings or seed. Thrives up to about 3,000 ft.

Jaffna- or Sea-Moss. "Ceylon Moss"; Kadala-passi, *T.* *Gracilaria lichenoides.* An edible, creamy-white sea-weed, found growing on the northern shores of Ceylon and parts of S. India, Malaya and Burma. The plants are collected, dried in the sun on mats for 2 or 3 days, then washed several times in fresh water and again exposed to the sun. The "moss" when dried is in the form of fine, string-like, white shreds and is very light. When boiled, strained and left to settle, it forms a jelly, which is emollient and demulcent, considered to be nutritive, and is used as a delicacy for invalids. The flavour of sea-weed may be disguised by the addition of milk, wine, or aromatics. In some countries sea-weeds are valued as food for stock in times of scarcity. (See *Manures.*)

AGATI OR KATURU-MURUNGA (*Sesbania grandiflora*).
(1) Cylindrical pods; (2) flowers.

Japanese- or Chinese-moss, Agar-agar. A preparation of sea-weed (chiefly *Gelidium*) familiar in the form of white, thin, shiny membranous flakes, obtained mostly from Japan. It is extensively used as a food adjunct, viz. as a thickener in jellies, soups, etc., also in sizing textiles, and in laboratories as a culture medium for bacteria. It is usually valued at about 5*s.* per lb. in England.

Moringa pterygosperma. *Moringae.* Horse-radish Tree; Drumsticks; Murunga, *S*; Murunga-kai, *T.* A short, slender tree, about 25 ft. high, with small tri-pinnate leaves, cultivated in gardens throughout Ceylon, India, etc. The roots are used as a substitute for horse-radish, the leaves for vegetable curries as well as for seasoning and in pickles, and the long unripe pods ("drumsticks") as a curry vegetable, the latter being boiled and sliced like beans. The flowers and bark are used in native medicine, and a valuable oil (Oil of Ben) is obtained in India from the seeds. Propagated by seed or cuttings.

Sesbania (Agati) grandiflora. *Leguminosae.* Katuru-murunga, *S*; Agatti-keerai, *T.* A small, erect, quick-growing, sparsely branched, soft-wooded tree, about 15–20 ft. high, bearing large pendulous flowers. The large fleshy petals as well as the tender leaves are relished in curries and soups, or fried with butter. The long pendulous pods do not appear to be eaten. The bark, leaves and flowers are medicinal. Propagated by seed. Commonly cultivated in Ceylon.

Solanum Melongena. *Solanaceae.* Brinjal; Egg-plant; Aubergine; Wambotu, *S*; Katrikai, *T.* A low bushy annual, usually with sharp prickles along the stems and leaf-stalks, commonly grown for its large, smooth fruit, which forms a favourite vegetable and is cooked and served in various ways. There are numerous varieties, differing chiefly in the shape, size, and colour of fruit, which may be round, ovoid or cucumber-

BRINJAL OR AUBERGINE (*Solanum Melongena*).
(1) Flower; (2) fruit in section.

shaped, and white, grey, or purple, the latter being usually characteristic of the best varieties.

Brinjals thrive best in a rather dry climate, with irrigation, and in rich, friable and well-tilled soil. They are grown most successfully in the drier districts of Ceylon, and are also suited to fairly high elevations, provided the climate is not too wet. Sow seed in a well prepared bed or in boxes, and transplant the seedlings when about 3 in. high into rows, about 2 × 2 ft. The plants should begin to bear in from 3 to 4 months, and continue to yield for 2 or 3 months. A crop of about 40,000 fruits (or about 8–12 fruits per plant) is considered a good yield. Cultivated as a summer crop in warm or sub-tropical climates.

Sorghum Durra. *Gramineae.* Guinea-corn; Kaffir-corn; Great Millet; Turkish Millet; Juar (India); Dhurra or Doura; Mazzagua; Karal-iringu, *S*; Cholam, *T.* A tall annual maize-like grass, 6–8 ft. high, cultivated from remote ages as a cereal food-crop. It requires similar conditions of soil to Maize and is suited to a rather dry climate. Largely cultivated in E. Africa, Egypt, Sudan, India, etc., often with irrigation, but seldom grown in Ceylon. The small hard grain is nutritious, being rich in albuminoids though lacking in gluten. It is made into flour, which is sometimes mixed with wheat flour and prepared in different ways for the table. The straw affords good fodder (*q.v.*). Seeds may be sown in furrows about 3½ ft. apart, and the seedlings subsequently thinned out to distances of 12 in. in the row. About 12 lb. of seed will sow an acre, or about 80 lb. if for fodder. In India the plant is often grown as a mixed crop, as with *Cajanus indicus.*

TYPES OF GUINEA-CORN OR DURRA (*Sorghum Durra*, vars.).

The seed should be sown before the end of the rains, so that the crop may be harvested in the dry season, that is, about 3½–4 months after sowing. The yield may vary from 22 to 26 bushels

or more per acre, according to variety and cultivation. When ready for harvesting, the ears, which should be perfectly ripe, are cut with a portion of the stalk attached; after drying for a few days these are ready for threshing. There are numerous varieties, differing in habit of growth, size of ears, and colour of grain, which may be white, cream, red, or black; the black-seeded varieties are generally known as Kaffir-corn, and the red as Dhurra. Well-known varieties are: Feterita, Dwarf Milo, Dwarf Kaffir and Pink Kaffir. Close-headed vars. are suited to dry climates, and loose-headed ones to a heavier rainfall. Birds are often destructive to the crop, and the only practical remedy is to employ scare-crows, or watchers with devices of rattling tins. (See *Dry Grains.*)

Spinach (*q.v.*); also *Basella, Amarantus, Portulaca,* etc. *Talinum* spp. (*Portulaceae*). Small herbs with oblong, succulent, tender leaves, which are edible and sometimes used for spinach, as are also those of other plants of this family.

Voandzeia subterranea. *Leguminosae.* Vandzon; Madagascar- or Bambarra-groundnut. A creeping annual with erect, long-stalked, trifoliate leaves. Like the common ground-nut, the flower-stalks, after flowering, bend down to the earth, in which they develop and ripen their 1-seeded pods. The plant does not, however, produce trailing branches, and the fruits are set close to the stem. The seeds ("nuts") are a common article of food in Madagascar and different parts of Trop. Africa, where the plant is cultivated and known by different names. In Zanzibar they are an article of local trade. It takes about 25 lb. seed to sow an acre, and the yield may be 16 bushels or more. Cultural requirements the same as for the common Ground-nut. The plant has been carried by the Negro slaves to certain parts of Trop. America, where it has become naturalised. It is known in Surinam as "Gobbe," in Natal as "Iguihluba" or "Hluba-bean," and in Madagascar as "Pistache Malgache."

Kerstingiella geocarpa. *Leguminosae.* A kind of ground-nut similar to the above in habit, found and cultivated in Togoland, etc. and known as "Kandela." It is a prostrate herb, rooting at the nodes and bearing white, red, or black seeds.

Zea Mays. *Gramineae.* Indian-corn; Maize; Mealies (S. Africa); Bada-iringu, *S*; Cholum, *T*. A coarse, quick-growing, annual, monoecious grass, 5–8 ft. high, with long and broad strap-shaped leaves, native originally of S. America, introduced at an early period into the Old World, and now cultivated in all warm countries, more especially in S. and N. Africa, India, Australia and the warmer parts of N. America. The unripe tender heads (cobs) are a nutritious and delicious vegetable, being prepared in various ways, as boiled in milk, roasted and served with butter, pepper and salt. When ripe the large, shiny, hard grains are ground into flour, from which cornflour and various other articles of food are made. In America they are also used in the manufacture of starch. Maize is, next to rice, the most important of cereal foods.

Cultivation and *yield.* The crop thrives under sub-tropical or warm temperate conditions, and at medium to high elevations in the tropics, except in very wet or wind-swept localities. A dry period for maturing the crop is necessary. Seed may be sown 2 or 3 in. deep and 6 or 8 in. distant, in rows 3 ft. apart, in well-tilled, rich and well-manured soil. The seedlings should afterwards be thinned out, leaving 12 or 15 in. between them. In rich soil, wider spacing is necessary, about 10–12 lb. being required to sow an acre. The plants should be earthed up when about 2 ft. high. The crop should be ripe in 3½–4 months, according to variety and climate, each plant producing from 2 to 4 cobs, which vary from 8 to 12 in. long. The yield per acre varies according to variety and local conditions from about 30 to 40 bushels grain, or about 8,000 cobs. A bushel of average grains weighs about 60 lb., and a pound contains about 1,500 seeds.

Varieties. These come under two main types, viz. "flint" and "dent" grains. "Flint" varieties are considered to ripen more rapidly than the "dents," though the latter are often preferred for cultivation. The plant is naturally subject to cross-fertilisation, so that varieties are numerous. Among the best and most distinct are: Pride of the North, Iowa, Silvermine, Longfellow Dent, Hickory King (sweet or sugar-variety with white seed), Golden Flint, Mastodon, and Waterloo. (See also *Fodder Plants.*)

CEREALS OR DRY GRAINS

Commonly Cultivated as Catchcrops in the Tropics

Suited to districts with limited rainfall, new clearings, etc.

Amarantus paniculatus, A. frumentaceus and other species. Amaranth; Pungkiray, *T*; Lansi-tampala, *S*; Sag (of Bengal). Robust, quick-growing annuals, 5–7 ft. high, with striated stems and long-petioled, ovate-lanceolate, bronze or reddish leaves, commonly cultivated in India, Ceylon and elsewhere, for the small black, white, or yellowish seed, which are an article of food with the peasants. The young leaves also are cooked and used as a vegetable. Other species, known in Ceylon as "Tampala," as **A. gangeticus, A. tricolor, A. melancholicus,** and **A. oleraceus,** handsome erect annuals, about 3–4 ft. high or more, and bearing small black seeds, are commonly cultivated for the leaves, which are used as a vegetable. Some are grown for ornament on account of their bright red or yellow foliage.

Chenopodium album. Bajar, Taku (India). An erect herb with toothed leaves and inconspicuous green flowers. The small seeds are eaten and considered by some superior to Buckwheat. The leaves are used as a pot-herb and green vegetable. Cultivated in Bengal, Punjab, etc. (See *Essential Oils.*)

C. Quinoa. Quinoa. S. American species, growing to a height of about 5 ft.; leaves glaucous, powdery grey beneath; seeds very small, shining and acrid, but on soaking and boiling the bitter property is removed. These form "a favourite dish in Chile, Peru, etc." 15,000 seeds go to an ounce.

Coix Lachryma. Job's Tears; Kikirindi, *S*; "Adlay" of the Philippines. A robust grass with broad leaves, 4–6 ft. high, common in Ceylon, cultivated and naturalised. In parts of India and Malaya it is cultivated as a cereal and for fodder. Cultural requirements the same as for Maize. The grain when milled into a flour is considered to have important food value, but owing to its low gluten content it should have a portion of wheat flour added. Several varieties are known. (See *Fodder Plants,* also *Ornamental Seeds.*)

Eleusine coracana. Kurrakan, *S*; Nacher, or Kel-varagu, *T*; Ragi of S. India and Malaya; Nachni (Bengal). An erect sedge, 2–3 ft. high, producing a terminal cluster of incurved spikelets, with small, round, reddish grain, commonly cultivated in Ceylon, India (especially in Mysore) and Malaya. It is suited to poor or rich soil, and yields from 700 to 1,000 lb. (say 12–16 bushels) of grain per acre, maturing a crop in 3–4 months. About 12 lb. of seed will sow 1 acre, and a bushel of seed weighs about 60 lb.

Fagopyrum esculentum. *Polygonaceae.* Buckwheat; Kotu, Bro, etc. (India). An upright, annual herb of rapid growth, with angular, hollow stems, hastate leaves, and small 3-angled fruit; cultivated in parts of India, Persia, etc., generally as a catchcrop on poor soils; the seeds are eaten by the poorer classes, and by the Hindus on feast days. It is bitter, and is regarded as heating and unpalatable. Seed rate 12–15 lb. per acre; if broadcast, 30 lb. Yield per acre, 600–800 lb.

Panicum miliaceum. Indian Millet; Meneri or Wal-meneri, *S*; Pani-chamai or Katakuny, *T*; Chena (India). An erect, annual grass, 2–3 ft. high, with rather broad hairy leaves and a much divided, nodding panicle. Largely grown in dry parts of India and to some extent in Ceylon and other warm countries for its grain, yielding about 500–600 lb. per acre. A bushel of the seed weighs about 60 lb.

P. miliare. Little Millet; Heen-meneri, *S*; Samai or Chamai, *T*; Kutki or Gundli (India). Annual tufted grass, 2–3 ft. high, with long drooping panicles, cultivated in India, Ceylon, etc. Yields 8–10 bushels per acre.

P. Crus-galli var. **frumentaceum.** Cockspur Grass; Sanwa Millet; Sanwa or Kheri (Bengal); Wel-marukku, *S*; Mondy, *T*. An erect, quick-growing grass, 2–4 ft. high, with large leaves and erect, rigid panicles composed of many incurved spikelets, cultivated in parts of India for its grain; common in the drier parts of Ceylon, often in paddy fields. The chief merit of the grain is its rapid yield, a crop being sometimes matured within six weeks of sowing. (See *Fodder Grasses.*)

Paspalum scrobiculatum. Koda Millet; Amu or Karal-amu, *S*; Varagu or Varaku, *T*; Kodaka (India). An erect perennial grass, 2½–4 ft. high, common in

India, Ceylon, etc., sometimes cultivated for its grain, which is of inferior quality and, having traces of poison, requires careful washing and preparation before use. Yields 400–500 lb. or more per acre. Several varieties are recognised.

Pennisetum typhoideum (*Panicum spicatum*). Pull-paddy; Bulrush- or Spiked-millet; Bajra (India); Kumbu, *T*; Pollu, *S*. An erect grass with stout, round stems, attaining a height of 4–6 ft. or more. Leaves broad; spikes terminal, cylindrical, smooth, dark brown, 6–9 in. long; extensively cultivated in parts of India. Requires about 5 lb. seed to sow an acre, which yields 500–600 lb. of grain in about 3 months from sowing. A bushel weighs about 50 lb.

Setaria italica. Italian Millet; Kangui (S. India); Kakun (Bengal); Shamai or Tinai, *T*; Tana-hal, *S*. An annual grass, about 2–3 ft. high, bearing cylindrical spikes with smooth grain, commonly cultivated in the drier parts of India, Ceylon, Siam, China, etc. Considered to be nutritious and digestible, being one of the best of dry grains. A yield of 600–800 lb. per acre should be obtained under favourable conditions.

(1) PULL-PADDY; Pollu, *S*. (*Pennisetum typhoideum*). (2) TANA-HAL, *S*; TINAI-CHAMBAI, *T* (*Setaria italica*).

Sorghum saccharatum (*Andropogon saccharatus*). Sugar Sorghum; Imphee, or Dheodan (India). An annual grass, cultivated in parts of N. India either for fodder or for the syrup obtained from the stems. The grain is sometimes used as an article of food. (See *Sugar Crops*.)

* ANALYSES OF VEGETABLES, PULSES, AND CEREALS.

BEANS AND PULSES:

	Water.	Albuminoids or Proteids (flesh-formers).	Carbohydrates (starch, sugar, etc.).	Oil or fat.	Fibre or cellulose.	Ash.
Arachis hypogaea. Ground-nut	7·5	24·5	11·7	50·0	4·5	1·8
Cajanus indicus. Pigeon-pea	10·5	22·3	60·9	2·1	2·1	3·0
Canavalia ensiformis. Sword-bean	12·5	25·0	48·6	2·8	7·0	3·4
Ceratonia Siliqua. Locust- or Carob-bean	14·6	7·1	67·9	1·1	6·4	2·9
Cicer arietinum. Chick-pea	7·5	24·5	11·7	50·0	4·5	1·8
Cyamopsis psoralioides. Cluster-bean	11·8	29·8	46·2	1·4	7·7	3·1
Dolichos Lablab. Lab-lab Bean	12·1	22·4	54·2	1·5	1·2	3·0
D. biflorus. Horse-gram; Wula-wala, *T*	11·0	22·5	56·0	1·9	5·4	3·2
Glycine hispida. Soya-bean; Bhat (India)	11·0	35·3	26·0	18·9	4·2	4·6
Lathyrus sativus. Vetchling; Khessari (India)	10·1	31·9	53·9	0·9	—	3·2
Lens esculentus. Lentils	11·8	25·1	58·4	1·3	1·2	2·2
Phaseolus Mungo var. Black- or Green-gram	10·8	22·2	54·1	2·7	5·8	4·4
P. vulgaris. Haricot-beans	14·0	23·0	52·3	2·3	5·5	2·9
P. lunatus. Lima-bean	13·3	19·7	57·8	1·2	4·3	3·7
P. aconitifolius. Moth-bean; Dew-bean	11·2	23·8	56·6	0·6	4·2	3·6
Vigna Catiang. Catiang-bean; Black-eye	12·5	24·1	56·8	1·3	1·8	3·5

OTHER VEGETABLES:

	Water.	Albuminoids or Proteids (flesh-formers).	Carbohydrates (starch, sugar, etc.).	Oil or fat.	Fibre or cellulose.	Ash.
Artichokes, Jerusalem	80·0	2·0	15·5	0·2	1·3	1·0
Beet, sugar	81·5	1·0	15·4	0·1	1·3	0·7
Cabbage, Drumhead (inner leaves)	89·4	1·5	7·0	—	1·3	0·8
Carrot	85·0	1·4	10·8	0·2	1·7	0·9
Cassava (meal)	34·1	2·2	60·4	0·8	0·8	1·7
Kohl-rabi or Knol-kohl	87·0	1·3	9·5	0·1	1·1	1·0
Lettuce	93·0	0·7	4·7	—	0·6	1·0
Parsnip	85·1	1·3	10·9	0·3	1·4	1·0
Peas	14·3	22·4	52·5	2·0	6·4	2·4
Potato	75·0	2·1	20·6	0·3	1·1	0·9
Pumpkin	89·1	0·6	6·5	0·1	2·7	1·0
Sweet-potato	65·5	2·1	29·2	0·7	1·7	0·8
Turnip	91·0	1·2	6·0	0·2	1·0	0·6

CEREALS:

	Water.	Albuminoids or Proteids (flesh-formers).	Carbohydrates (starch, sugar, etc.).	Oil or fat.	Fibre or cellulose.	Ash.
Avena sativa. Oats (grain)	14·3	12·0	55·7	6·0	9·3	2·7
,, ,, (meal)	10·5	11·0	52·2	4·5	14·5	6·8
Coix Lachryma-Jobi. Job's Tears	13·2	7·3	73·2	1·5	2·5	2·3
Eleusine coracana. Ragi; Kurrakan, *S*	13·2	7·3	73·2	1·5	2·5	2·3
Fagopyrum esculentum. Buckwheat	14·0	9·0	58·7	1·5	15·0	1·8
Oryza sativa. Paddy; Goyan, *S*; Arisi, *T*	12·8	7·3	78·3	0·6	0·4	0·6
Panicum Crus-galli var. frumentaceum.	12·0	8·4	72·5	3·0	2·2	1·9
P. miliaceum. Indian Millet	12·0	12·6	69·4	3·6	1·0	1·4
P. miliare. Little Millet; Shamai, *T*	10·2	9·1	69·0	3·6	4·6	3·5
Paspalum scrobiculatum. Koda Millet	11·7	7·0	77·2	2·1	0·7	1·3
Pennisetum typhoideum. Bulrush Millet	11·3	10·4	71·5	3·3	1·5	2·0
Secale cereale. Rye (grain)	14·0	11·0	67·4	2·0	3·5	1·8
Setaria italica. Italian Millet; Tinai, *T*	10·2	10·8	73·4	2·9	1·5	1·2
Sorghum vulgare. Guinea-corn; Dhurra	12·5	9·3	72·3	2·0	2·2	1·7
Sorghum saccharatum. Imphee	12·8	11·8	68·3	3·0	3·0	1·1
Triticum vulgare. Wheat (grain)	14·4	13·0	66·4	1·5	3·0	1·7
,, ,, ,, (meal)	12·6	11·8	74·1	1·2	0·7	0·7
Zea Mays. Indian-corn; Maize	12·5	9·5	70·7	3·6	2·0	1·7

* "Food Grains of India," by Prof. A. H. Church.

EDIBLE FLOWERS IN THE TROPICS

Various flowers are edible and relished in different countries, either as an article of food or for flavouring purposes. In Europe, violets, primroses, Indian-cress (*Tropaeolum*), pot-marigolds (*Calendula*), rose-buds and other flowers are used in special salads or preserves. The following are some of the principal flowers used for food in tropical or sub-tropical countries.

Abutilon esculentum. Fls. commonly used as a vegetable in Brazil.

Banana. Young flower-heads commonly used as a vegetable in Ceylon, etc.; used in China for pickling.

Bassia latifolia. Illipi; Mahwa; Indian Butter-tree. In India the fleshy fls., produced in February, are dried and eaten by the peasants, the average annual yield per tree being about 200 lb. It is estimated that some 25,000 tons of the fls. are gathered in India every year. These are sometimes used for the extraction of alcohol. **B. longifolia.** Mee, *S*. A medium-sized tree similar to the

above but with narrower lvs., found chiefly in S. India and Ceylon; used in India for similar purposes to the Mahwa. (See *Oils*.)

Bombax malabaricum. Red Cotton-tree; Katu-imbul, *S*. The fleshy calyces of the large red fls., collected as they drop, are much relished as a curry vegetable in Burma.

Calligonum polygonoides. Phogalli. *Polygonaceae*. Fls. eaten in N. India, being made into bread or cooked with butter.

Hibiscus Sabdariffa. Rozelle. The fleshy, persistent, enlarged calyces are used for flavouring and for making jelly, etc. (See *Trop. Fruits*, also *Fibres*.)

Ipomoea Bona-nox. Moon-flower. The fleshy calyces are commonly used as a curry vegetable in Ceylon.

Lilium Thunbergii. The fls. form a choice culinary delicacy in China.

Rivea ornata. *Convolvulaceae*. The fleshy fls. are eaten in the North of Ceylon; not cultivated.

Sesbania (Agati) grandiflora. Fls. much relished when boiled or fried. (See *Vegetables* and *Food Crops*.)

EDIBLE HERBS, ETC., USED AS FOOD IN CEYLON BY THE POORER PEOPLE, BUT NOT CULTIVATED

SHOWING PARTS USED

Acalypha indica. Kuppamaniya. *Euphorbiaceae*. Lvs.
Achyranthes aspera. Gas-karal-heba. *Amarantaceae*. Lvs.
Acrostichum aureum. Kere-koku. *Filiceae*. Tender fronds.
Aerva lanata. Pol-kudu-pala. *Amarantaceae*. Stems and lvs.
Allmania nodiflora. Kumatiya. *Amarantaceae*. Lvs.
Alternanthera triandra. Mukunu-wenna. *Amarantaceae*. Tender stems and lvs.
Amarantus gangeticus. Sudu-tampala. **A. polygonoides.** Kura-tampala. **A. spinosus.** Katu-tampala. Tender stems and lvs.
Aponogeton crispum. Kekatiya. *Naiadeae*. Tuberous roots.
Argyreia populifolia. Giritilla. *Convolvulaceae*. Tender lvs.
Asparagus falcatus. Hathawariya. *Liliaceae*. Young shoots and roots.
Asplenium esculentum. Miwana-kola. *Filiceae*. Tender fronds.
Atriplex repens. Elichchevi. Foliage eaten as a vegetable at Jaffna.
Boerhaavia diffusa. Peta-sudupala. *Nyctagineae*. Lvs.
Cassia auriculata. Ranawara; **C. occidentalis.** Peni-tora; **C. tomentosa**; **C. Tora.** Peti-tora. Tender pods, lvs. and fls.
Celosia argentea. Kirihenda. *Amarantaceae*. Stems and lvs.
Ceratopteris thalictroides. Kudamahu-weralla. *Filiceae*. Succulent fronds.
Commelina clavata. Girapala. *Commelinaceae*. Stems and lvs.
Costus speciosus. Tebu. *Scitamineae*. Tuberous roots.
Cycas circinalis. Madu. *Cycadeae*. Sago made from seeds.
Dregia volubilis. Kiri-anghuna. *Asclepiadeae*. Lvs.
Gynandropsis pentaphylla. Wela. *Capparideae*. Aromatic lvs.
Hibiscus furcatus. Napiritta. *Malvaceae*. Young tender lvs.
Hydrocotyle asiatica. Hin-gotu-kola. *Umbelliferae*. Stalks and lvs.
Impatiens flaccida. Kudalu. *Geraniaceae*. Stems and lvs.
Klugia notoniana. Diya-nilla. *Gesneraceae*. Lvs.
Lasia spinosa. Kohila. *Araceae*. Tender lvs.
Leucas zeylanica. Geta-tumba. *Labiatae*. Lvs.
Lippia nudiflora. Herimena-kola. *Verbenaceae*. Lvs.
Marsilea quadrifolia. Diya-embul-embiliya. *Rhizocarpeae*. Stalks and lvs.
Monochoria hastaefolia. Diya-habarala. *Pontederiaceae*. Tender stalks and lvs.
Nasturtium officinale. Kakutu-pala. *Cruciferae*. Stalks and lvs.
Nelumbium speciosum. Nelun. *Nymphaeaceae*. Seeds.
Nymphaea Lotus. Olu. *Nymphaeaceae*. Seeds.
Oxalis corniculata. Heen-embul-embiliya. *Geraniaceae*. Stalks and lvs.
Pandanus latifolius. Rampe. *Pandanaceae*. Young lvs. for flavouring.
Polypodium quercifolium. Bainduru. *Filiceae*. Young fronds in bud.
Portulaca oleracea. Genda-kola; **P. quadrifida.** Heen-genda-kola; **P. tuberosa.** Urugenda-kola. Stems and lvs.
Solanum indicum. Tibbatu; **S. nigrum.** Kalukanweriya; **S. xanthocarpum.** Ela-batu. Tender fruits and lvs.
Trapa bicornis (*q.v.*). Ikiliya. Fruit (nuts).
Typhonium trilobatum. Panu-ala. *Araceae*. Tender lvs.

CHAPTER XXIII

TEMPERATE OR SUB-TROPICAL VEGETABLES AND FOOD-CROPS

THE following include vegetable crops suited chiefly to sub-tropical conditions, or to elevations of about 3,000 ft. upwards. Many may be grown with moderate success in the cool season at lower elevations, some even at sea-level. Market gardens for the cultivation of "European" vegetables on commercial lines are carried on very successfully all the year round at 5,000–6,000 ft. in Ceylon, S. India, etc., and at gradually lower altitudes according to distances N. and S. of the equator. In the sub-tropics, however, as the summer heat increases, such vegetables can often only be grown successfully in the "winter" or cool season. (See pp. 201, 206.) For convenience of reference it is considered preferable in this case to give precedence to the common or "English" name over the botanical, the former as a rule being the more familiar. The botanical name and family are given in brackets. (See also *Trop. Vegetables*.)

Aracacha, or Peruvian Parsnip. (*Arracacia esculenta*. Umbelliferae.) A low Parsnip-like plant, producing edible, starchy, tuberous root, the flavour of which has been compared to a combination of parsnips and potatoes; native of Peru, where it is cultivated up to 7,000 ft. altitude; introduced at Hakgala Gardens, Ceylon, in 1884. It is propagated from seed, or by division of the small heads or stems which arise from the rootstock, the setts being planted in rows about 20 in. apart. It takes from 10 to 12 months to mature a crop, but some tubers may be gathered for use 2 months earlier if required. The plant will thrive in any good soil, and is best adapted to the higher elevations. Commonly cultivated in Colombia up to 8,000 ft.

Artichoke, Chinese. (*Stachys tuberifera*. Labiatae.) A dwarf herbaceous perennial, bearing underground white spiral-like tubers, 2–2½ in. long and about ½ in. thick. They are eaten in China either cooked as a vegetable, or raw like radishes, and resemble the latter in flavour, with a suggestion of the Jerusalem Artichoke. The plant has been found to thrive at Hakgala Gardens, but has not become popular in Ceylon as a vegetable, and is apparently very little known in the tropics.

Artichoke, Globe. (*Cynara Scolymus*. Compositae.) The edible part is the tender unexpanded round or broadly cone-shaped flower-head, which when cooked is much relished as a vegetable. The plant thrives to perfection at Nuwara Eliya, Ceylon, growing sometimes in a semi-naturalised state, but is unsuited to elevations below 4,000 ft. Propagated by seed or suckers, preferably the former. Seed should be sown early in the year, in boxes or pots under cover but exposed as much as possible to the light, otherwise the seedlings are apt to damp off. The seed should germinate in 10 or 12 days after sowing. Prick out the seedlings when strong enough into a well-prepared and sheltered bed, and when these are about 4 in. high, plant them out 3 × 4 ft., in rows. Good heads should be produced in about 8 months from the time of planting. The plant thrives best in a rich moist soil, as by the side of water channels or

streams, and is worth growing for ornament on account of its large, handsome, deeply cut, glaucous leaves. Among the best of many vars. are " Green Globe " and " Purple Globe."

Artichoke, Jerusalem (from *girasole*, Italian). A better name is "Root-artichoke." "Sun-root" has also been suggested. (*Helianthus tuberosus.* Compositae.) This is one of the most successfully cultivated of temperate vegetables in the tropics and, strangely, it often thrives better in the low-country than at the higher elevations. It flourishes in indifferent soils, but does best in rich, well-manured and moist soil. Normally the plants reach a height of about 6 ft. or more, but in the tropics they usually grow to only about half that height.

ASPARAGUS (*Asparagus officinalis*). In young culm state, ready for picking.

At the commencement of the rainy season, plant the tubers in rows about 2½ ft. apart and about 10 in. distant in the row. Pick off any flowers as they appear. A crop of tubers may usually be obtained in about 3 months from planting, the largest being first searched for and picked from the sides of the rows. When the remainder are taken up they should be covered with dry earth or sand, and used as required. In the tropics the tubers deteriorate to some extent, so that new setts should be imported from time to time. The yield in temperate countries is usually from 4 to 6 tons per acre. (See *Vegetable Analyses.*)

Asparagus. Hartha-wariya, *S.* (*Asparagus officinalis.* Liliaceae.) The cultivation of this delicious vegetable is hardly suited to the tropics, though at fairly high elevations or under sub-tropical conditions some measure of success can be obtained. The young tender shoots are the parts used. The plant is a gross feeder and requires a rich, friable and well-drained soil, which should be heavily manured.

Being a native of the sea-coast, it is considered to benefit from a sprinkling of salt applied to the surface soil once a year. It is best to import strong 3-years old roots once every 2 or 3 years or so; but fresh stock can, if desired, be raised from seed, which should be sown in boxes under shelter. When the seedlings are a few inches high they should be planted out in large, deep holes, care being taken not to injure the delicate roots. In cool countries the seed is generally sown in the beds where the plants are to remain, and a bed of Asparagus is in its prime when five years old, and lasts for a number of years. For the first two years none of the shoots or branches is cut, the plants being first encouraged to make strong crowns or root-stocks.

In Mauritius, Stockdale states: Seed is sown annually, and the plants when one year old are transferred to their permanent beds. The latter are prepared by digging trenches 3 ft. wide to a depth of 16–18 in. About 6 in. of good soil is placed at the bottom of the trench, followed by 3 or 4 in. of well-rotted cattle manure, finishing with about 2 in. of fine soil. The " roots " are then planted out about 15 in. apart and covered with 6 in. of good soil mixed with leaf-mould and more manure. The plants are allowed to grow, flower and seed, and are then cut down; the soil is removed from the roots and replaced with good rotten manure and fresh soil mixed with a little salt. The next crop of asparagus is cut until it begins to become tough; then it is allowed to run to seed, and after the seed has ripened the plants are cut down again and treated as above. " Connover's Colossal " and " Reading Giant " are good varieties.

Bean, Broad- or **Windsor-.** (*Vicia Faba.* Leguminosae.) Broad Beans are seldom grown successfully in the tropics. The plants set fruit sparingly even in the cool dry months, and the pods are usually small and lacking in flavour. The production of pods may, however, be encouraged by pinching back the tops of the plants when in blossom and by artificially pollinating the flowers with a fine brush. In Ceylon, seed is best sown in October or November. The seeds should be soaked in hot water for some hours, and then sown 4 in. apart, in drills about 18 in. distant, covering them with 2 in. of good soil. Deep and well-tilled soil are the crop's chief requirements. Two distinct types are the " Long Pod " and " Broad Windsor," the former being considered the better suited to the tropics. The Broad-bean is considered to be a native of S.W. Asia. In Mesopotamia it has the appearance of being indigenous or naturalised.

Beans, Kidney-, or **French-.** (*Phaseolus vulgaris.* Leguminosae.) Bonchi, *S.* This excellent vegetable can be grown in the moist and cool season at all elevations from sea-level, but to most perfection at 4,000–6,000 ft., and is commonly cultivated in market gardens. The different varieties come under two distinct classes, viz. (*a*) " Dwarfs," which attain a height of 14–18 in. and do not need stakes for supports; (*b*) tall or Runner Beans, which are climbers and grow 6–8 ft. in length, requiring supports. The cultural requirements of both sorts are the same. The former come into bearing earlier, and are more prolific, than the Runner Beans, which, however, continue productive for a longer period.

The seeds should be sown in well-manured soil, in rows 18 in. apart for " dwarfs " and 3 ft. for climbers, with 6 in. and 10 in. respectively between the seeds in the rows. Frequent sowings should be made so as to keep up a succession of crops; sowings made towards the end of the monsoon rains give the best crops, as they are not liable to be damaged by heavy rains. The seeds germinate quickly, and the plants usually come into bearing in about six weeks from the time of sowing. Among the best of the *dwarf* sorts are: Canadian Wonder, Butter Beans, Mont d'Or, Sutton's Perfection, and Wax Pod or " Murunga-bonchi," with cylindrical long stringless pods. *Runner Beans:* Epicure, Excelsior, White Long Pod, etc.

Beans, Scarlet-Runner. (*Phaseolus multiflorus.* Leguminosae.) A herbaceous perennial climber with scarlet flowers, native of S. America, the long pods of which are used in a tender state like French-beans. The plant is seldom cultivated in Ceylon, as it has been found unsuited to the climate at any elevation, for although it grows and blossoms freely it seldom produces pods.

Beet or **Beetroot.** (*Beta vulgaris.* Chenopodiaceae.) This is considered the most nutritious of root crops, next to the potato, and contains about 12% of sugar. Boiled, sliced and served with vinegar it is especially relished, as in salads, etc. The plant grows well in up-country gardens, and

at low elevations often yields a fair-sized succulent root, which is the part used. The plant generally thrives best in rich, deep soil and is especially benefited by a potash fertiliser. Being naturally a native of the sea-coast, an application of salt is sometimes recommended.

Cattle manure, if used, should be in a thoroughly decomposed state. The ground should be dug deeply and well broken up. Sow the seed thinly in drills about $1\frac{1}{2}$ in. deep by 12 in. apart and cover with fine soil, afterwards lightly pressing down the surface. The seed germinates in about 10 days. The seedlings must be thinned out to at least 6 in. apart when well above the surface, and those removed may be transplanted if desired. A crop should be obtained in $2\frac{1}{2}$–3 months.

Varieties are numerous and come under two distinct forms, the Globe or Turnip-rooted and Long-rooted. On the plains acclimatised seed is considered to give the best results. Occasionally pale-fleshed tubers are met with. These are usually discarded as worthless, and are distinct from the white-fleshed Sugar-beet (*B. saccharatum*), which has green leaves.

Leaf- or **Spinach-Beet.** Chard. (*Beta Cicla.*) A species of beet grown for its leaves, which are used as spinach and sometimes for flavouring soups, the roots being of no use. Cultural treatment the same as for the above.

Borecole, Kale, or **Curly Greens.** (*Brassica oleracea acephala.* Cruciferae.) A variety of cabbage characterised by very crumpled or curly leaves, which spread out in plume-like fashion and do not form a compact head. These are not considered fit for use in Europe until they have had some frost. Owing to their ornamental appearance, they are often employed for garnishing, as well as for cooking purposes. They can be grown successfully at medium and high elevations, but are more suited to a cold climate. Cultural directions the same as for Cabbage.

Broccoli. (*Brassica oleracea botrytis.*) This is a kind of Cauliflower in which the flowers do not form a compact head; it is grown as a winter crop in cool countries, but is unsuitable for cultivation in the tropics.

Brussels Sprouts. (*Brassica oleracea gemmifera.*) This favourite vegetable is a variety of Cabbage which, instead of forming one single head, produces numerous small heads or "sprouts" crowded along the stem towards the top, the stem being 2–3 ft. high.

It is a winter vegetable in Europe, but thrives at high elevations in the tropics and is commonly grown in up-country gardens. Cultural requirements are similar to those of the Cabbage. Sutton's Matchless, Aigburth and Dwarf Gem are all good varieties.

Cabbage ; Gova, *S.* (*Brassica oleracea* var.) This useful vegetable is grown abundantly in up-country gardens, and excellent specimens, sometimes weighing up to 18 lb. or more, may often be seen. At low or intermediate elevations, in moist districts, it thrives sufficiently well to yield at least a crop of green leaves, which are picked as required and relished by the peasants for vegetable curries. The plant requires a rich, well-drained and manured soil. Seed may be sown thinly on a sheltered border of smooth, friable soil; when the plants are 4 or 5 in. high, they should be planted out at distances of about $1\frac{1}{2}$ ft., in rows about 2 ft. apart. The young plants require to be shaded until strong enough. Heads should be formed and fit for picking in about 3 months after planting. In the tropics, propagation is often by cuttings from shoots which appear on the stem; plants thus raised are less susceptible to the club-root disease than those obtained from seed.

The Club-root or Finger-and-toe disease, to which the Cabbage family is specially liable, is the greatest drawback to cabbage cultivation in the hill districts (see *Fungus Diseases*). The ground usually becomes infested with it after the first crop of cabbage is grown, so that a change of soil for each crop of the latter is advisable. As a preventive, fresh slaked (powdered) lime may be applied at the rate of about 6–8 oz. or more per sq. yd. All diseased plants should be burned. "Cut-worm" (Black-grub) is also a very destructive pest to young cabbage plants. (See *Insect Pests.*) Sutton's Maincrop, Early Battersea, Early York, and Drumhead are among the best varieties.

Cabbage, Red. (*Brassica oleracea capitata rubra.*) This thrives well at 4,000-6,000 ft., but is not much grown in Ceylon. It is used chiefly for pickling. Cultural requirements are similar to those of the Cabbage. The principal varieties are Red Drumhead, Red Dutch, and Dwarf Red.

Cabbage, Savoy. A dwarf variety of Cabbage with much wrinkled or crimped leaves, usually forming firm and rather flat heads. Thrives well at high elevations, and is considered a delicacy; not commonly grown in Ceylon.

Cabbage, Shantung. (*Brassica chinensis.*) Also known as "Choude Chine" and "Pe-tsai." A species of Cabbage, shaped like a Cos lettuce and weighing when well-grown 5–6 lb. or more.

This has long been in high repute in China as a vegetable. Mr. Hughes, late Commissioner of Customs at Chefoo, stated: "When boiled it is nearly as good as Sea-kale; eaten raw, in a salad, it is of so delicate a flavour that I know of no vegetable in England to approach it." This cabbage thrives best in moist, rich soil, and has the advantage of standing the rain well, growing rapidly to a size fit for consumption. It is grown from seed, the seedlings being planted in rows about 20 in. apart, with about 15 in. between the plants in the rows. When nearly full grown, the heads should be tied up so as to encourage them to form a firm, white heart.

Capsicum. (See *Trop. Vegetables*, also *Spices.*)

Cardoon. (*Cynara Cardunculus.* Compositae.) A perennial plant, much cultivated on the continent of Europe for its fleshy mid-ribs, which, however, are not much relished in England. It is seldom grown in Ceylon, and its cultivation elsewhere in the tropics seems equally uncommon. Seedlings may be raised under cover, and planted out in trenches about 3 ft. apart, with a distance of 18 in. between the plants in the rows. Later on, the earth is drawn up to the plants as in Celery cultivation, for the purpose of blanching the leaves.

Carrot. (*Daucus Carota.* Umbelliferae.) This popular vegetable can be grown very successfully at medium to high elevations, and also on the plains with some success. In up-country market gardens carrots are among the best grown vegetables. A deep, rich, sandy soil which has been manured for the preceding crop is the most suitable; fresh manure and hard or clayey soil must be avoided. Seed should be sown thinly in drills 12 in. apart, the young plants being afterwards thinned out to distances of 3–4 in. Further thinning out may be continued by pulling for use the largest or most crowded plants. The best way of storing carrots is to cover them in a heap of damp sand, in a dry airy shed.

Varieties. These are divided into two distinct classes, viz. the *Long-rooted*, which comprises the Altringham, James Intermediate, White Belgian, etc.; and the *Short-rooted* or *Horn* kind, including Scarlet Dutch Horn, Early Short Horn, etc.

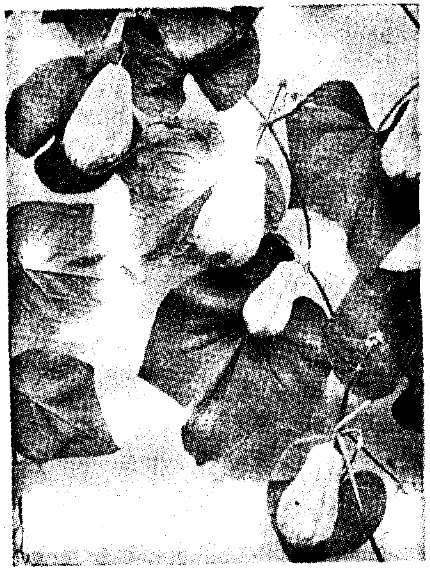
Cauliflower. Mal-gova, *S.* (*Brassica oleracea botrytis.*) This delicious vegetable is a variety of Cabbage, the dense white flower-heads being the part used. It thrives in the tropics at the higher elevations, also on the plains in the cold weather, during which very fine crops may be produced, as in S. Persia and Mesopotamia. Deep, rich and well-manured soil suits it best, and an application of newly slaked lime should be given before planting out. General cultivation the same as for Cabbage. Acclimatised seed, obtained chiefly from N. India, are said to give the best results in Bengal. (See *Cabbage*, also *Fungus Diseases.*)

Varieties. Among the best are: Sutton's Giant, Walchereen, Dean's Early Snowball, and Large Asiatic.

Celeriac ; Turnip-rooted or Knob-Celery. (*Apium graveolens rapaceum.* Umbelliferae.) A variety of Celery, the stem of which forms an irregular knob, which

as well as the leaves is used in salads and for flavouring soups, etc. It can be grown from 1,500 ft. upwards, but there is little to recommend its cultivation where Celery can be grown.

Celery; Seldry, *S.* (*Apium graveolens.* Umbelliferae.) This can be grown with great success in up-country gardens, and even in the low-country or on the plains very fair stalks can be produced, while the plant is worth growing for the sake of the leaves alone for flavouring purposes. The essential conditions for Celery culture are constant moisture and rich, well-manured and deep soil. The small seed should be sown in a box under cover, the seedlings being afterwards pricked out into beds or boxes; when about 4 in. high, plant these out about 6–8 in. apart in a deep trench, having filled the bottom of which to a depth of 6 in. with good manure mixed with some rich soil. Later, a little fertiliser, as a potash or phosphatic mixture, may be given.



CHO-CHO, OR CHAYOTE (*Sechium edule*).

Blanching of the stems or leaf-stalks is effected by depriving them of the light, *i.e.* in practice by drawing up the soil to the plants at intervals as they grow, the leaves meantime being loosely tied, or held together by means of boards placed temporarily against them. A good method of blanching is to take a piece of bamboo about 18 in. long and slit it in two; having pointed the ends, drive these into the earth, close on either side of the plant; the latter, encompassed by the bamboo, is then earthed up, the bamboo sections being afterwards removed. Celery takes about 4 months from the time of sowing to be ready for use.

Varieties. Among the best are Wright's Giant Groove, Sutton's Giant White, Golden Yellow, and Mammoth White.

Cho-cho, Cayote, or Chayote; Christophine. (*Sechium edule.* Cucurbitaceae.) A perennial robust creeper, with leaves like those of the Cucumber, native of Trop. America, introduced to Hakgala Gardens, Ceylon, in 1884. It is suited to the higher elevations in the tropics, and is also commonly cultivated in the sub-tropics. In the Mediterranean region it is known as Chayote. The plant has become well established in Ceylon, especially in the hill districts, and thrives from 1,000 ft. upwards; but it is not much cultivated here, not being in general demand as a vegetable. Propagation is effected by planting the entire 1-seeded fruit *in situ*, in mounds of well-manured soil. It requires natural or artificial supports for the vines to grow over, and thrives up-country without shade, but is benefited by light shade at lower elevations.

The pear-shaped, pale-green or white, warty or wrinkled fruits, 4–6 in. long, are very popular as a vegetable in its native home, the W. Indies, also in Madeira, etc., being used like vegetable-marrow. They are in season almost throughout the year, the plants commencing to bear in 3–4 months after planting. Well-grown fruits

weigh from 2 to 3 lb. each; these are sold in the local markets at about 1*d.* each, and are sometimes seen in Covent Garden, London. The plant produces a tuberous starchy root, which is relished by some as a vegetable. In Mexico this is boiled and candied, or sliced and fried for table use. The white-fruited variety seems better adapted for the low-country than the green form.

Chou Moellier, or Cabbage Broccoli. (See *Fodder Plants.*)

Cress, Garden. (*Lepidium sativum.* Cruciferae.) A small annual, commonly cultivated in temperate countries for the sake of the young leaves, which are used uncooked in salads. It is a very quick-growing and short-lived plant, being ready to cut for use within a few days after sowing. Seeds may be sown broadcast on a smooth surface, in a box or bed, which should be shaded from the sun. Frequent sowings are necessary in order to keep up a succession of cuttings.

Cress, Indian. Nasturtium. (*Tropaeolum majus.* Tropaeolaceae.) The flowers as well as the young leaves of several varieties of the annual Tropaeolum are much relished by some in salads. The unripe fruits are also used in pickles. The plants are readily grown from seed and thrive at medium to high elevations; they are also very ornamental, both the dwarf and the climbing varieties, the latter being quick-growing and useful for covering trellis-work, fences, rocky banks, etc.

Cress, Water. Kakkutu-pala or Wataressa, *S.* (*Nasturtium officinale.* Cruciferae.) A low perennial herb, native of Europe, etc., naturalised in Ceylon, being commonly met with in swampy situations, as in the neighbourhood of rice fields, or by streams at high elevations. The pinnatifid pungent leaves are, in the young state, a favourite salad herb, though not often used as such here. Water-cress may be readily propagated from seed or cuttings, or by divisions of the old plants, and is easily grown in a patch of soil through which water is made to flow; stagnant pools are unsuitable for it. In New Zealand, where the plant has been introduced, it has become a formidable pest, having become established in almost every water-course and spring.

Cucumber. Rata-kekiri, *S.* (*Cucumis sativus.* Cucurbitaceae.) The superior varieties of Cucumber, cultivated to such perfection in hot-houses in cool countries, can only be grown with success in the tropics where a greenhouse or a good heating frame is available. Such protection is necessary in order to enable equable conditions of temperature and moisture to be maintained. The hardier Ridge-cucumbers may, however, be grown in the open like Pumpkins.

Excellent specimens of cucumbers have been grown in frames in hill gardens, though these are seldom attempted by market gardeners in Ceylon. Seeds may be sown in pots or boxes under cover, and the seedlings planted out in rich soil when about 3 in. high. Pinch out the tips of the plants when about 8 in. high, and afterwards the point of each shoot 2 in. beyond the young fruit, so as to encourage the latter to swell. A good substitute for the "English" cucumber is found in the native Pipingha. (See *Trop. Vegetables.*)

Endive. (*Cichorium Endivia.* Compositae.) An annual of N. China, cultivated for its stocky head of curly leaves, which when young and tender are used in salads and other preparations. The plant is of easy culture, and may be seen occasionally in up-country gardens. Propagated from seed.

Horse-radish. (See *Seasoning Herbs*, also *Moringa.*)

Knol-kohl or **Kohl-rabi.** (*Brassica caulo-rapa.* Cruciferae.) This vegetable holds a place intermediate between the Cabbage and the Turnip, and is supposed to combine the flavour of both. The stem above ground grows into a turnip-like head, and is the part used. The plant is often erroneously referred to as the turnip-rooted Cabbage, a different plant, the tuberous root of which is used. Knol-kohl thrives remarkably well in the low-country, being able to resist heat and drought better than most vegetables of the Cabbage family. Seed should be sown in drills

about 15 in. apart, the plants being afterwards thinned out to a distance of 9 in. in the row; or seedlings may be raised in a box or sheltered bed, and transplanted like Cabbage. The best time for sowing is at the commencement of the monsoon rains. There are several *green* and *purple* varieties, the green sorts being usually preferred. The crop should be fit for the table in about 8–10 weeks from sowing.

Leeks. (*Allium Porrum.* Liliaceae.) Leeks thrive to perfection at the higher elevations, but their cultivation is seldom worth attempting below 2,000 ft. Sow seeds on a sheltered bed or in boxes, before the commencement of the monsoons; prick out the seedlings when large enough to handle, and transplant these at distances of 8 in. into well-manured, deep trenches. As the plants increase in height, the trench should be filled in gradually with earth so as to encourage the production of long, thick, succulent and blanched stalks, which are the part used. Leeks require deep, rich soil, plenty of manure and constant moisture. The London Flag and Musselburgh are old favourite varieties, which are probably still unsurpassed.

Lettuce. Salada, *S*; Khus (Arabic). (*Lactuca sativa.* Compositae.) This takes first place as a salad plant, and can be grown at almost all elevations in the tropics, but to most perfection in the hills. The plant is an annual, prefers a rich, mellow, humous soil, and responds well to manuring. Sowings should be made at intervals of 3 or 4 weeks so as to keep up a succession. It is best to sow the seed in shallow drills on a well-prepared bed, afterwards thinning out the plants to about 12 in. apart; or the seed may be sown in seed-pans or boxes, and the seedlings transplanted out when they have obtained their second pair of leaves.

In the tropics the plants soon run to seed. A method sometimes adopted to retard or prevent this is to cut the tap-root below the surface of the soil, this being also considered to have the effect of causing the plants to form good hearts. For the latter purpose it is also advisable to place a loose soft tie round the middle of the plants. Ground pests are particularly partial to Lettuce. Mixing some ground insecticide, as Vaporite, with the soil a few days before sowing, or sprinkling some freshly slaked lime or salt on the surface, is recommended.

Varieties. These come under two classes, viz. Cabbage-lettuce (from the round cabbage-like heads, with broad leaves), and Cos-lettuce, the latter being distinguished by erect, conical heads and rather narrow, pointed leaves. The former is considered the better kind for a wet climate, but the Cos is supposed to be more crisp and sweet; it does not, however, form so good a heart as the Cabbage sorts. There are numerous sub-varieties, as White Dutch, Golden Queen, Little Gem, White Silesian, Green Paris, etc. The bronze-leaved kind is not generally liked.

Maize. See *Trop. Vegetables.* Strictly a sub-tropical crop.

Mushrooms. Included in the family *Agaricaceae* are mushrooms and toadstools, which are characterised by having the spores borne on the gills (*lamellae*), usually placed below the cap (*pileus*). In Ceylon the vernacular names Bim-mal (Sinh.) and Ka-lang (Tamil) are applied to all fungi. While many of the tropical fungi, whether growing naturally on the soil or on decayed tree-trunks, etc., are edible, others are undoubtedly very poisonous. It is not always easy, especially for inexperienced persons, to distinguish between these, though some people consider they can always do so. The best forms of mushrooms are usually those which, when young, are in the form of round, white buttons; when a day or two old they open out like an umbrella, the gills (under side) becoming purplish black.

Poisonous kinds, which in some cases resemble these characters, are said to turn to a bright yellow colour when cooked. Fungi with a slimy skin, or which when broken or bruised show a deep blue colour, should be avoided. Petch, late Government Mycologist, Ceylon, prefers not to lay down any hard and fast rule by which a novice may attempt to identify an edible from a poisonous fungus, and considers that actual experience is the best guide. Nor does he attach much importance to the reputed nutritive value of edible fungi generally, an opinion shared by many other botanists. In temperate countries, however, mushrooms are regarded by many as a table delicacy, and are largely cultivated, being also extensively exported in hermetically sealed tins.

For growing mushrooms the following hints may be useful. A dark and fairly dry room is essential; a room or cellar in an unused shed or out-house will answer the purpose. Excessively wet or dry atmosphere and a high temperature must be avoided. Horse-dung, freed from grass or straw, should be collected daily, and kept under cover until a sufficient quantity has been secured. It should be spread evenly over the floor to prevent rapid fermentation. A bed is then made, about 2½ ft. deep, consisting of alternate layers of the prepared horse-dung and good loamy soil, finishing with a layer of the latter on the top. The whole being beaten down firmly, the bed should be allowed to settle and ferment for about a week.

Small cubes, about an inch square, of mushroom spawn are then planted on the surface, about 6 in. apart and an inch deep. Water the whole thoroughly and, if the weather be dry, sprinkle the surface of the bed every morning and evening with water. A crop of mushrooms may be expected in 6 weeks from the date of "spawning," and the beds should continue productive for at least 2 months. Mushroom spawn in brick form may be imported from nurserymen. This should be stored in an air-tight tin until required for planting. Imported spawn in this form is usually prepared from the mycelium of *Agaricus campestris*, the common field mushroom of Europe, which is not indigenous to Ceylon and can only be cultivated successfully in the hill districts.

Oca-quira, Melluco, or **Ulluco.** (*Ullucus tuberosus.* Basellaceae.) A small herb. perennial of Peru, where it is cultivated for its tubers, which are consumed like potatoes. Introduced at Hakgala Gardens, Ceylon, in 1885, it grew rapidly and produced tubers from 2 to 3½ in. long and shaped like a "kidney potato"; but it failed to become popular here as a vegetable. Usually the tubers do not grow to so large a size as that mentioned. The plants trail over the surface of the ground, rooting and producing a number of small tubers at each node. In good soil a crop should be mature in about 4 months from planting. Suited to sub-tropical conditions.

Onion; Lunu, Rata-lunu, *S.* (*Allium Cepa.* Liliaceae.) Onions thrive best in the tropics at the higher elevations and in rather dry districts, preferring a light, open soil enriched with well-decomposed manure. The seed may be sown broadcast on raised beds, or in shallow drills about 12 in. apart, covered with a sprinkling of fine soil, pressing the surface down gently, as with the back of a spade or a flat board. Or the seed may be sown in a nursery bed or in boxes, and the seedlings transplanted when strong enough into well-prepared beds. Seed-rate of about 5 lb. per acre is usually allowed for. The plants, when thinned out, should not be closer than 6 in. in the drill, and should be as near the surface as possible so as to encourage the bulbs to increase in size. Further thinning may be effected by using the young plants as "spring onions." A good crop may yield from 3 to 4 tons or more per acre.

Varieties. Ailsa Craig, Blood-red, Sutton's A1, and Tripoli are leading sorts. In India, acclimatised varieties, as Silver-skin or Patana-onion, and the large "Red-onion," are recommended for the plains.

Egyptian Onion. This produces on the flower-stalks bulbils of the size of marbles, which are used for pickling. Offset bulbs are also formed underground, and propagation is effected by both forms.

Potato Onion. This is propagated by offsets produced underground, which are comparatively small in size and irregular in shape. The bulbs are planted singly, and around these new ones are formed. See *Shallots.*

Welsh Onion. (*Allium fistulosum.*) This affords the popular "Spring onions" of temperate countries. It is quite distinct from the common onion; no bulb is formed, the young tender stem being the part used.

Parsley. (See *Seasoning- and Pot-herbs.*)

Parsnip. (*Pastinaca sativa.* Umbelliferae.) This vegetable can be grown most successfully in up-country gardens, especially in sheltered and moist situations with loose, deep and rich soil, but does not thrive in the tropics much below 3,000 ft. Its cultural requirements are similar to those of Carrots, but the plant, being more robust, needs greater space than the latter. Seed is best sown in drills about 18 in. apart, the plants being thinned out when a few inches high to distances of about 9 in. in the row. Medium-sized roots are preferred to very large ones, which are liable to be woody at the core.

Peas. Bola-kadala, *S*; Pairu, *T*. (*Pisum sativum.* Leguminosae.) Peas of very fair quality can be grown in the hill districts, whilst at lower elevations also appreciable crops may be obtained if seed be sown in well-manured soil, after the first "burst" of the monsoon is over. In India as well as Ceylon, "acclimatised seed" often yields better crops than imported seed, especially on the plains. A small variety, imported from India as a foodstuff and commonly sold in the boutiques in Ceylon, will, if sown, often give fairly good crops in the low-country. It grows to a height of about 3 ft., and bears short pods with small grey seeds. Rich soil, deep cultivation, a liberal supply of manure, and sufficient but not excessive moisture are required to grow good peas. If the soil is heavy or inert, a sprinkling of lime is beneficial. In dry periods a mulching of decomposed cattle-manure should be given. An application of nitrate of soda when the plants are well above ground will give them a good start. Much rain as well as drought is unfavourable to the crop; therefore, sowings should be made before the end of the monsoon rains. If the ground be dry, watering should be resorted to.

Sow in drills, which should be 4 in. deep, the seeds being about 3 in. apart and covered with about an inch of soil. As the plants grow, earthing up must be attended to, and when they are about 6 in. high, twigs or stakes should be placed along both sides for support. The distance between the rows (drills) may be about 2 ft. for dwarf varieties, and up to 4 ft. for larger kinds. Where space has to be economised, the rows may be further apart and catchcrops grown between.

Varieties. These are numerous, and many differ little but in name. The following are more or less distinct and of first-rate quality: Telephone (4 ft.), Sutton's Excelsior (about 18 in.), Little Gem (15 in.), Fillbasket (3 ft.), Sutton's Ideal (3 ft.), Yorkshire Hero (2 ft.), and Captain Cuttle (4 ft.). The dwarf and medium-sized varieties are, as a rule, the most suitable for the tropics, tall sorts which grow to a height of 5 ft. or more being less satisfactory. Sugar Peas ("Sans Parchemin" of the French) have sweet, fleshy pods, which may be eaten whole or used in stews.

Potato. Arthapel, *S*; Urula-kelengu, *T*. (*Solanum tuberosum.* Solanaceae.) Very fair crops of potatoes can be grown at the higher elevations in the tropics, as in the neighbourhood of Nuwara Eliya, and more especially in the drier districts of Udapussellawa in Ceylon. At Bangalore, two crops a year can be obtained, and at some of the hill stations in India and elsewhere in the tropics excellent potatoes are produced almost all the year round. Potatoes planted at Calcutta early in January yielded tubers of good size and quality by the end of March, but the best results are obtained when planted early in November. In yield, however, potato crops in the tropics are seldom comparable to those of temperate countries. Within 10–15 degrees of the equator they are hardly worth growing under 4,000 ft. elevation.

The best conditions are a friable, moist loam, gently sloping ground with good natural drainage, and a moderately dry climate. The ground must be well manured and occasionally limed, and a change of soil for each crop is essential. The following fertilisers are recommended: 5 parts superphosphate, 2 of sulphate of ammonia, and 3 of kainit; apply about 4 oz. of the mixture per running yard of row. The best time for planting varies according to district; usually from July to September, and February to April, will be found the most satisfactory periods in Ceylon, and in India generally from September to December. New potatoes, fit for consumption, should be obtained in 2½–3 months from the time of planting.

In gardens potatoes are usually planted at distances of about 12 in., in drills 24 in. apart, and in fields about 12 × 30 in. respectively. Taking setts weighing about 2½ oz. each, or of the size of a hen's egg, about 8 cwt. should be sufficient to plant an acre. The practice of dividing the tuber into two or more setts, or cutting a slice off the root end, is not to be recommended, as it has been found from experiments that uncut medium-sized tubers give the best yield. Sprouting tubers, in shallow boxes or trays under cover, before planting out, is also sometimes adopted in cool countries. A yield of about 5 tons per acre in the tropics may be considered a good return, though in temperate countries the average yield may be 6–7 tons or more.

Potato crops are liable to disease in the tropics as elsewhere. The most common diseases in temperate countries are the Potato Blight (*Phytophthora infestans*), appearing as brown patches on the leaves, which eventually turn black and die, and the Wart-disease (*Synchytrium endobioticum*). Both affect the tubers, which become unfit for eating. Spraying the haulms and foliage with Bordeaux- or Burgundy-mixtures as a preventive has of late become a recognised practice, the spraying being usually done twice or three times, at a fortnight's interval, before the crop begins to mature. In Ceylon, a prevalent disease is Ring Blight (*Bacillus Solanacearum*), which appears as a black ring when the tuber is cut across (see *Fungus Diseases*). The larvae of the Potato moth, which has been imported into India with seed-potatoes, have become a troublesome pest in that country; consequently seed-potatoes from India or other countries where the pest exists should be fumigated at the ports of entry. Protection from frost by means of cadjans, brackens, or other covering is necessary in hill gardens during the cool-weather period. The following are among the leading sorts: *Early varieties:* Ninety-fold, Epicure, May Queen, Midlothian, Duke of York, Sharp's Express. *Middle Season varieties:* British Queen, King George, Stirling Castle. *Main-crop* or *late varieties:* King Edward, Arran Chief, Windsor Castle, Great Scot, Factor, Iron Duke. (See *Useful References.*)

In addition to the Potato being an excellent food, it is also largely used for alcohol, starch, etc. The fruit, however, is poisonous and should not on any account be eaten. See *Solanum Commersoni*, p. 314.

Radish. Rabu, *S*. (*Raphanus sativus.* Cruciferae.) Radishes are easily grown at all elevations. The seed, if sown broadcast on a smooth bed, will germinate in 2 or 3 days, and the roots are ready for use in about 3 weeks afterwards. Sowing should therefore be made at frequent intervals to keep up a succession. Radishes do best in a moist and partially shaded situation. The young plants should at first be thinned out to 2 or 3 in. apart, further thinning being effected by taking up the largest as these become fit for use. There are numerous varieties, which differ mainly in the shape of the succulent root, this varying between long, ovoid, and turnip-rooted. "Cabbage-radish" is a name applied to a large variety, introduced from India, commonly grown by the peasants in Ceylon, chiefly in the low-country. The outer leaves are picked as required and used as a vegetable, but the large, spongy root is seldom eaten.

Rhubarb. (*Rheum Rhaponticum.* Polygonaceae.) This popular vegetable can be grown with much success in hill gardens, but is quite unsuited to low or even intermediate elevations. The use of the succulent leaf-stalks for tarts, stewing, etc., is of comparatively modern origin. Formerly the leaves only were used as a pot-herb, like spinach, but this is risky as they contain oxalic acid. Rhubarb thrives best in rich, deep, moist soil, in a sheltered and shady situation. In Europe it is usually propagated by division of the roots or crown, but in the tropics it is often raised from imported seed, which should be sown every second or third year in order to keep up a strong stock.

Salsify. Oyster Plant. (*Tragopogon porrifolius.* Compositae.) This is of easy cultivation up-country, except during the heavy monsoon rains, and is commonly grown in hill gardens. The root, which is not unlike a thin, slender parsnip, is the part eaten; it is about the thickness of the fore-finger, about 9 in. long, and is fit for use in 3–4 months from the time of sowing the seed. The plant thrives in deep, rich and well-manured soil. Seeds may be sown in drills, after the heavy rains are over, the seedlings being afterwards thinned out to about 4 in. apart. The milky roots are prepared for the table in various ways, being par-boiled, cut into large pieces and fried in butter; or they may be boiled, then grated and made into cakes. The flavour has a fancied resemblance to that of an oyster.

Scorzonera. Viper's Grass. (*Scorzonera hispanica.* Compositae.) A herbaceous perennial, native of S. Europe, similar to Salsify but differing in having broader leaves and black-skinned roots. The latter are the part used, and they are considered by some to be superior to Salsify. The leaves also are edible and used in salads. The same cultural conditions as for Salsify will suit Scorzonera; but the roots of the latter take longer to become ready for use. The plant is seldom grown in Ceylon. **S. deliciosa.** A species characterised by a sweeter flavour than the above; extensively cultivated in Sicily, etc.

Sea-kale. (*Crambe maritima.* Cruciferae.) This vegetable, the young blanched and crisp shoots of which are used, is seldom if ever grown in the tropics, the climatic conditions, even at the higher elevations, being usually unsuited to it.

Shallots; Red-onions; Rathu-lunu, *S.* (*Allium ascalonicum.* Liliaceae.) A small, bulbous perennial, grown for its bulbs, which are used for flavouring purposes much in the same way as garlic; they do not, however, possess so strong an odour or flavour as the latter. Shallots are imported into Ceylon from India, and sold in almost every bazaar or boutique, being commonly known as "small onions" and largely used for curries, pickling, etc. They may be grown successfully in a rather dry climate, at medium elevations, and thrive best in light, rich soil, responding well to an application of potash (see *Fertilisers*). They may be planted in drills about 9 in. apart, with a space of 6 in. separating the bulbs in the drill. Plants may also be raised from seed.

Solanum Commersoni. (Solanaceae.) A comparatively new vegetable, allied and similar to the common Potato, the tuber being violet or purple; introduced from Uruguay. Grown experimentally in England in 1902, at the instance of the Board of Agriculture, this plant gave promising results, "yielding heavily and being found entirely resistant to disease." It "appeared to be susceptible to cultivation, and rapidly improved when grown in fertile soil," giving a yield at the rate of about 6½ tons per acre, "without any manuring or cultivation beyond a single hoeing when the shoots first appeared." The plant is considered best suited to a rather wet soil. It was introduced at Hakgala Gardens, Ceylon, in 1909, and yielded fair-sized tubers, closely resembling the common potato both in appearance and eating quality, but the yield was poor as compared with the latter.

Sorrel. (*Rumex Acetosa.* Polygonaceae.) A perennial herb, native of Europe, sometimes grown for its acid leaves, which are either used in salads, or boiled and used as spinach. Sorrel is seldom cultivated in the tropics, but is suited to up-country gardens, and may be propagated and grown like Spinach, preferring a shady situation. Sow seed in drills one foot apart, and thin out the plants afterwards as may be required.

Spinach. (*Spinacia oleracea.* Chenopodiaceae.) A stemless annual herb, native of N. Asia, cultivated in cool countries for the sake of its soft edible leaves, which may be cut repeatedly and when cooked and served in various ways form an agreeable vegetable. Spinach thrives well at medium and high elevations with but little trouble, but is seldom grown in market gardens in Ceylon. As it takes up but little space and is soon ready for cutting, it may be sown between rows of slower-growing crops, such as Peas. Seed may be sown during the rains, in drills about a foot apart, the young plants being afterwards thinned out as may be necessary. Spinach loves a rich, moist and friable soil, a shady situation and liberal watering in dry weather.

Spinach, New Zealand. (*Tetragonia expansa.* Chenopodiaceae.) A tall annual herb, native of New Zealand, the leaves of which are used in the same manner as Common Spinach. It is coarser than the latter, has rather hairy, glaucous leaves, and is of easy culture. It grows luxuriantly in hill gardens in the tropics, where it often reproduces itself from self-sown seed. Seed may be sown in drills about 18 in. apart, the seedlings being afterwards thinned out as required.

Spinach Beet. (See *Beet.*)

Spinach, Native. (See *Basella*, *Amarantus*, *Boussingaultia*, etc.)

Tomato. Takkali, *S*; Takkali-kai, *T*. (*Lycopersicum esculentum.* Solanaceae.) A semi-climbing herbaceous annual, with fleshy, pinnatifid, strongly-scented leaves, native of Trop. America, commonly grown in all warm countries for its fruit, which are esteemed in salads and for sauces, soups, etc. Tomatoes can be grown with much success in the tropics, especially in rather dry districts and at medium elevations, as in Uva and Dumbara in Ceylon, under sub-tropical conditions. In wet districts they thrive under the eaves or protection of a house. They do best in deep, rich, loamy soil, and should not be grown for more than one season consecutively in the same ground. Imported seeds of good varieties should be used when possible, though seed from selected fruits grown locally may yield satisfactory crops.

The seed should be sown thinly in pots or boxes, the seedlings being afterwards planted out, when strong enough, into boxes or tubs, or on a sheltered border facing the morning sun, as under the eaves of a house. In dry localities, where irrigation may have to be resorted to, they should be planted on raised beds, so that the stems may not become submerged. Supports for the plants must be provided in the form of firm stakes, a fence, or low trellis. The plants are best trained to a single stem and cut back to a height of 5–6 ft., according to position, the side shoots being pinched back, also the leaves if too luxuriant. Phosphatic and potash fertilisers are especially recommended, being conducive to fruitfulness.

In prolonged wet weather, protection from heavy rains should be afforded, as otherwise the fruit may split, become distorted, or fail to ripen. Enclosing the fruit, whilst on the plant, in thin paper or muslin bags is recommended as a protection from insect pests. When the fruits fail to ripen on the plants in wet weather, they may be picked green, if they have attained approximately full size, and kept on a shelf in a dry, sunny place for a few days to ripen.

Turnip. (*Brassica rapa.* Cruciferae.) Turnips of very good quality can be grown at the higher elevations, and even on the plains very fair roots may be obtained in the cold weather. In the hill districts they are regularly grown for home consumption or for market purposes, the best crop being produced in the drier seasons.

They thrive on light soil enriched with well decomposed manure, and are not adapted to a stiff, retentive soil. Seed may be sown broadcast on well prepared beds, or in shallow drills about 16–18 in. apart, the seedlings being thinned out when 3 in. high, allowing a spacing of about 6–10 in. in the row; further thinning may be effected by picking the largest for use as required. The best time for sowing, in India and Ceylon, is before the end of both monsoons. The enlarged

tuberous root is the part used. *Varieties.* Amongst the best are Early Snowball, White Dutch, Red Globe, and Sutton's Perfection. On the plains acclimatised varieties are said to give the best results.

Udo or **Oudo.** (*Aralia cordata.* Araliaceae.) A herbaceous perennial with large pinnate leaves, attaining a height of 5–6 ft. or more. The young and blanched stalks, when from 10 to 16 in. long, are eaten as a salad vegetable in Japan, where the plant is extensively cultivated in private as well as in market gardens. It grows freely at Peradeniya (1,500 ft.), but is not used here as a vegetable.

Vegetable Marrow. (*Cucurbita Pepo.* Cucurbitaceae.) This agreeable vegetable is commonly and very successfully grown in up-country districts, but is not suited to low elevations in the tropics. The plant grows rapidly and trails over the ground, producing its large, oblong gourds, which should be picked before they have attained full size, as they are at that stage most palatable. Seed may be sown thinly in a box, the stronger seedlings being selected when a few inches high and transplanted singly into well-prepared mounds of rich soil and manure, about 6 ft. apart. The plant is an annual and monoecious, *i.e.* the sexes are in separate flowers on the same plant. The female flowers must therefore be fertilised, either by insects or by hand, with pollen from the male flowers, as otherwise no fruit will set. The female flowers can be readily distinguished by their large and roundish base (ovary), also of course by their having no pollen.

CHAPTER XXIV

SPICES, CONDIMENTS, AND SEASONING HERBS

SPICES

From remote ages the spices of the tropics have attracted traders from distant lands, and formed a lure for adventurous explorers. Some of the ancient cities of Europe are said to have been indebted for a large share of their wealth to the trade in tropical spices during the time of the Romans. In China spices were held in high esteem from time immemorial (see *Cloves*). Cinnamon, which has long been associated with the "spicy breezes" of Ceylon, was from very early times perhaps the most coveted of all spices. It is mentioned in the Song of Solomon and in the Book of Proverbs, and has from ancient times been used for sacrificial offerings. The Arabs supplied it to the Greeks and Romans, but jealously shrouded in mystery the source of its origin and the manner of obtaining it. Being first brought from Ceylon to the western coast of India, it was carried thence to Arabia and Egypt by African and Arab traders, finally reaching Europe after a journey of many months. (See also *Pepper*.)

The search for cinnamon was the chief incentive of the Portuguese in discovering the route round the Cape to India and Ceylon in 1505, and it is said that the spice was brought to the conquerors as a tribute by the Sinhalese kings. The Dutch, obtaining possession of the Island in 1656, made cinnamon a state monopoly, which continued till 1833. At one time cinnamon was sold in London for £8 per lb., while other spices commanded similar fabulous prices. In 1826 the English import duty alone on pepper was 2*s.* 6*d.* a lb., on cinnamon 3*s.* a lb., on nutmegs and mace 3*s.* 6*d.* a lb. each, on cloves 5*s.* 7½*d.*, and on vanilla nearly 17*s.* per lb. As recently as 1880 cardamoms were sold for over 9*s.* a lb.

Distribution of Spices. For a long period the supply of the different spices was confined to their native habitat, as nutmegs and cloves from the Moluccas, or "Spice Islands," and cinnamon from Ceylon. These were at one time claimed as the property of the Government of the country, and their cultivation was subject to severe official restrictions, an infringement of which was met by rigorous penalties or even capital punishment. The cloves and nutmeg trees were so guarded in the Moluccas that the plants were either deliberately destroyed, or their cultivation was enforced, to suit official requirements. An amusing story told in this connection is to the effect that the Home Dutch Government once despatched orders to their Colonial governor requesting him to reduce the number of nutmeg trees and increase the number of mace trees, being ignorant of the fact that both spices were the product of the same tree. But even nowadays this fact is not perhaps generally known.

It is recorded that the Dutch Government of that period thus exterminated the clove and nutmeg trees in certain islands so as to confine the supply of these spices to Banda and Amboyna. This, after all, was only another form of restriction, which is now officially recognised as necessary for the regulation of supplies of rubber, tea and other crops. The escape of the precious spice plants, however, to other countries was gradually effected, both by smuggling and, it is said, by the agency of migrating birds. The French succeeded in 1770 in introducing the clove tree into Mauritius and Réunion, whence it reached Zanzibar, now the principal clove-producing country. Jamaica obtained the Ginger plant from India, and had long practically commanded the supply of that spice, while Réunion and Seychelles became important sources of Vanilla, whose native home is Cent. America.

Allspice (*Pimenta officinalis*).

Uses of Spices. Spices form an important class of vegetable products, being valued in cookery, confectionery, the preparation of beverages and liqueurs, and in perfumery. Several are of special importance in medicine, either on account of their effect in aiding the digestion by increasing the gastric juices, or for disguising nauseous decoctions. The antiseptic and preservative properties of certain spices, due to their volatile oils, both in domestic and scientific uses, are well known. Some are also known as insect repellents, *e.g.* pepper. The appropriateness of spices to sacred uses, as for burning in incense, has long been recognised, and in certain social religious customs of oriental countries spices are to this day commonly employed (see *Cinnamon*). It is recorded that spices were used in the funeral pyres of the Egyptian kings, and that Nero burnt at the obsequies of his wife "a quantity of cinnamon and cassia exceeding the whole importation into Rome for one year." Not the least virtue of certain spices is their effect in sweetening the breath, more especially in countries where "betel-chewing" is practised (see *Betel*). For this purpose cardamoms (*q.v.*) are commonly used and much esteemed in India, Ceylon, etc., and Star-anise in China and Japan.

The following are the principal spices of the tropics, given in alphabetical order, with brief descriptions and notes on their cultivation and uses.

Allspice ; Whole-spice; Pimento; Jamaica Pepper. (*Pimenta officinalis.* Myrtaceae.)—A small tree with smooth greyish bark, 25–30 ft. high, native of W. Indies and Trop. America. The dried, unripe but full-grown berries, which are of the size of small peas, glossy black when ripe, are the allspice or pimento of commerce. The name "allspice" is from a supposed resemblance of the spice to a combination of the odour and flavour of cinnamon, nutmegs and cloves. The tree was introduced to Ceylon early in the last century. At Peradeniya, it flowers in the dry weather and usually produces a small crop of fruit in July–August, but it is rarely met with in this country outside the Botanic Gardens. It is

considered to yield best in a hot and rather dry climate, preferring a friable and well-drained soil. Heavy or clay soils are unsuitable.

The berries are picked when mature but still green, and are then dried on mats in the sun, this taking from 6 to 10 days, according to weather. The fruits are sufficiently dry when they become black and when, on shaking, the seed rattles inside. Gathering is effected by means of a long stick with a crook at the end, the fruit-bearing clusters being broken off and thrown down; the berries are then picked off the stalks by women and children. The tree, under favourable circumstances, begins to bear at the age of 7 or 8 years, but is not usually in full bearing until about 15–18 years old, when it may yield as much as 100 lb. of the dried spice. Jamaica is the only source of the spice at present, its annual export being about 8 or 9 million pounds. The spice is used for flavouring and in medicine, and is generally marketed now at about 4*d.* per lb. An essential oil (*Pimento oil*) obtained from the lvs. and used in perfumery, etc., is valued in London at about 4*s.* per lb.

Allspice, Lemon-scented. (*Pimenta acris* var. *citrifolia.*)—This distinct spice-tree was introduced in 1888 from Dominica to Peradeniya, Ceylon, where it has become well established, being about 45 ft. high and of an erect, slender habit; but it rarely fruits here. The leaves are strongly aromatic, and emit on crushing a delightful lemon-scented odour, but the oil produced from these is in little demand.

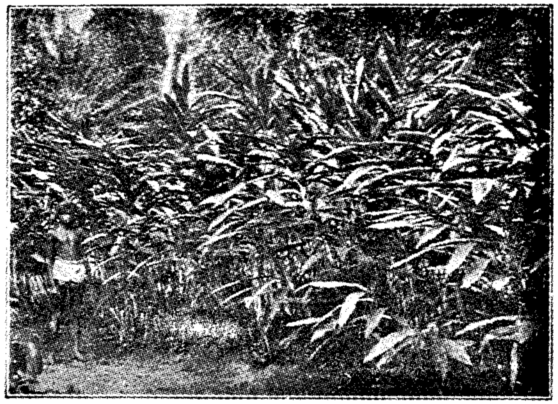
Allspice, Carolina. (*Calycanthus fertilis.* Calycanthaceae.)—An ornamental shrub of California, the aromatic bark of which is carminative and used locally in country medicine.

Allspice, Japan. (*Chimonanthus fragrans.* Calycanthaceae.)—A shrub with small, pale yellow fragrant flowers, similar to the preceding species.

"Mysore" Cardamom (*Elettaria Cardamomum*). (A) Flower buds; (B) dried fruit capsules of commerce.

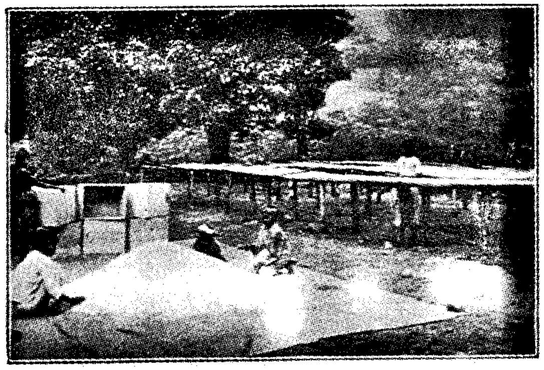
Bay Tree ; Bay Berry; Oil of Bay. (*Pimenta acris.* Myrtaceae.)—A small, erect, W. Indian tree, similar to *P. officinalis.* The aromatic leaves yield by distillation an oil which with rum is used to form Bay-rum, etc. The trees may be plucked in 3 years from planting, and 100 lb. green leaves yield on average about 17 oz. of oil, which normally fetches about 5*s.* per lb., while the usual return per acre is estimated to be at least 53 lb. of oil. The tree has been long established at Peradeniya, Ceylon, but seldom bears seed there. The dried leaves, obtained mostly from trees in a wild state, as well as those of the Allspice tree, are exported from parts of the W. Indies, chiefly to the U. States, for the extraction of the oil.

Canella-bark; Wild or White Cinnamon. (*Canella winteriana.* Canellaceae.)—A medium-sized tree, 30–40 ft. high, native of the W. Indies and Trop. America. The orange-coloured bark is bitter and aromatic, and is exported to a limited extent, chiefly from the Bahamas, for medicinal purposes. It is prepared in the form of long quills similar to cinnamon, and yields about 1% essential oil. In the W. Indies the bark is used as a condiment, and in Porto Rico the twigs are thrown on the water to stupefy fish in order that they may be easily caught. (See *Drugs.*)



CARDAMOM PLANTATION.

Cardamoms; Ensal or Enasal, *S*; Alaka or "Cardamungu," *T.* (*Elettaria Cardamomum.* Scitamineae.)—A tall, herbaceous perennial with large leafy basal shoots, 8–12 ft. long, and strong, creeping rootstock (rhizomes), native of the moist forests of Ceylon and S. India. In cultivation it thrives best between 2,500 and 4,000 ft., in moist humous soil, under light natural shade, as a sloping jungle which has been cleared of undergrowth. Protection from strong winds is essential, and trees should be planted for this purpose and for light shade where deficient. The spice consists of the ovoid fruit capsules, or rather the numerous small brown angular seeds which they contain; these have a powerful aromatic odour and flavour.



DRYING CARDAMOMS ON TRAYS AND TRESTLES; ALSO PACKING IN LEAD-LINED CHESTS.

Harvesting, curing, etc. The capsules are gathered before they are fully ripe, washed free from grit, and placed on mats or large hessian trays supported on trestles, on which they are slowly dried and bleached in the sun. The use of such trays enables their removal indoors at night or when a shower threatens. Formerly it was customary to bleach the capsules over sulphur fumes in a closed chamber, after which they assumed a pale straw colour, which was appreciated in the trade. Now, however, they are dried and marketed in their natural bleached or greenish-yellow colour. The capsules vary in size and shape, from ½ to ¾ in. long, and from oblong to ovoid; they are graded accordingly, the grades being known as "longs," "mediums," "shorts," etc. Shrivelled and insufficiently ripened fruits form an inferior quality. They are then packed in lead-lined chests for export. In addition to their use as a spice, as in confectionery, curry powders, etc., they are also valued in medicine. In India they are a reputed aphrodisiac, and are esteemed for use with masticatories or for sweetening the breath; in a sugar-coated state, they are much used at Hindu festivals and ceremonials.

Cultivation and yield. Propagation is by division of the crowns (rhizomes) or by seed, which take 2–3 months to germinate, in well-prepared nursery beds. In planting out, 3–4 plants or rhizomes are placed in each hole or clump, the latter being spaced about 10 ft. each way. In good soil a small crop may be obtained in the second or third year from planting, and from the fourth or fifth year, when in full bearing, an average yield of about 150–250 lb. or more per acre may be procured, according to cultivation, nature of soil, etc. Heavy rains while the plants are in blossom reduce the crop by preventing the flowers from setting. The plants are to some extent in bearing all the year round, but chiefly during the dry periods, viz. February–March (principal crop) and August–September, the crop being gathered once a fortnight or three weeks. The fruits should be cut with small, pointed scissors, not pulled by hand, and gathered when three-quarters ripe; if left to ripen fully they are liable to split open and disperse the seeds.

Prices fluctuate according to quality and demand, the present quotation in London being about 2*s.* 6*d.*–3*s.* per lb. for "capsules," and about 8*s.* for "decorticated" (*i.e.* seed). One pound contains about 800 capsules of average size, each of the latter containing 14–17 seeds. 8 lb. of capsules produce 2½ lb. of seed, and about 50,000 seeds go to a pound. The chief country of consumption is America. Germany was a large consumer before the War. Ceylon and S. India, especially Travancore, are the chief sources of production, the estimated area under Cardamoms in the former country being some 7,000 acres. The export from Ceylon has recently decreased from about 850,000 lb. to about 343,000 lb. in 1933.

CASSIA BUDS, OR YOUNG FRUITS (*Cinnamomum Cassia*).

Varieties. Two distinct varieties found in cultivation are known as "Mysore" and "Malabar." The former is distinguished by the erect or arching racemes, which bear the flowers and fruit, and by the leaves being glabrous on both sides; while in the "Malabar" the racemes are pendulous or trailing, and the leaves are softly pubescent on the underside. The former is therefore preferred for cultivation, as the fruits are not so liable to get damaged or soiled as those of the trailing variety. "Nepal," "Bengal," "Java," "Bastard" (of Siam) are forms derived from various species of *Amomum* which are of local importance only. The Wild-cardamom of Ceylon bears the largest capsules, which sometimes attain 1½ in. in length.

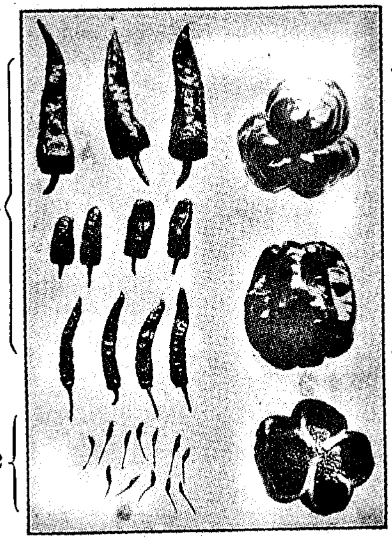
Pests. Damage is sometimes caused to the young crop by monkeys, wild pig, rats, porcupines, etc. Snakes, which probably come after the rats, are sometimes encountered. Lizards (*q.v.*) also are said to be partial to the fruit.

Cassia Bark; Cassia Lignea; Chinese Cinnamon or Cassia. (*Cinnamomum Cassia.* Lauraceae.)—A medium-sized tree, 40–50 ft. high, with long, lanceolate, brittle leaves, allied to Cinnamon, native of and cultivated in Indo-China, etc. It was introduced in 1882 at Peradeniya, Ceylon, where it thrives and bears fruit, usually in July–August. "Cassia" has been known from the earliest times as a spice. It is mentioned in the Bible and by early Greek authors, also in Chinese herbals as early as 2700 B.C. The whole tree is pleasantly aromatic, and its bark is used as a substitute for the true cinnamon, to which, however, it is considered inferior. It is commonly cultivated in its native country for its bark, unripe fruit (*Cassia Buds*), as well as leaves, from which an oil is obtained

by distillation. Cassia Buds are used in medicine, and broken bark in *Mixed Spice*. The tree is propagated from seed and requires similar conditions of soil and climate to cinnamon.

Unlike cinnamon, the tree is not grown as a bush, so that the bark is obtained from the branches, which are periodically cut down for this purpose, the bark being stripped off and made up in bundles for export, not quilled like cinnamon. The yield per acre is given as about 11 piculs (1 picul = 133⅓ lb.), and the selling price is about 30 Malayan dollars per picul. Cassia Buds are quoted at about 80*s*. per cwt. in London, and Cassia-oil, obtained from the leaves as well as bark, at about 3*s*. 6*d*.–4*s*. per lb. (See *Essential Oils*.)

Chillies; Red Pepper; Capsicums; Agi; Miris or Gas-miris, *S*; Kochikai, *T*. (*Capsicum spp.* Solanaceae.)—Small annual or perennial, herbaceous, shrubby plants, 2–4 ft. high, cultivated in all warm regions for their very pungent fruits, which are usually an indispensable flavouring ingredient in the food of people in tropical countries. The red, sun-dried, pod-like fruits are ground to powder and used in pickles, sauces, medicine, and with other spices to form Cayenne Pepper.



TYPES OF CHILLIES.
Left: Pungent vars.; (1) *Capsicum frutescens*; (2) *C. minimum*; (3) *C. grossum* or "Bell Pepper," not pungent; (4) Cross-section of same.

Most of the numerous cultivated varieties have probably been derived from the following species, viz.: *Capsicum minimum* (Birds'eye-chillie or Guinea-pepper) with small erect fruits; *C. frutescens* (Goat- or Spur-pepper); *C. annuum* (Capsicum- or Pod-pepper) with pods about 3 or 4 in. long; and *C. grossum* (Bell-capsicum or Bull-nose pepper). The last named is free of the burning pungency peculiar to the others, and may be used as a vegetable or in salads, having, when tender, a sweet, pleasant flavour. (See *Trop. Vegetables*.)

Chillies thrive best in rich, humous and well-tilled soil; they will grow up to 3,000 ft. or more above sea-level, but are not generally suited to a wet climate. Seeds may be sown in beds, and the seedlings planted out in well prepared ground when 3–4 in. high, being spaced about 2½ × 2 ft., say 8,000 plants to the acre. A crop is obtained in about 5–6 months from planting, and the yield may be at the rate of about 2,000–4,000 lb. or more dried chillies per acre. E. African and Zanzibar Chillies are valued in London at about 35*s*. to 50*s*. per cwt. Nepal Chillies usually fetch the highest price. The spice is largely exported from India, Zanzibar, Natal, E. Africa, W. Indies, etc.

Cinnamon; Kurundu, *S*; Kuruva, *T*; Darchini (India). (*Cinnamomum zeylanicum*. Lauraceae.)—A moderate-sized or large tree, 40–60 ft. high, with 3–5-nerved alternate leaves, native of the moist low-country of Ceylon and S. India. Although cinnamon was one of the earliest known spices, its systematic cultivation does not appear to have been undertaken till about 1770, first by the Dutch. Previous to this the spice was derived from wild or uncultivated trees. It was the first

article of importance exported from Ceylon, and at one time commanded a fabulous price. (See p. 317.) It has until comparatively recent years been one of the most popular of spices, but the demand has now largely declined and this together with the consequent lowering of prices has resulted in large areas being now replaced with rubber or coconuts. Some 35,000 acres are estimated to be still under the product in Ceylon, which is the only source of supply, with the exception of small quantities from Java and Seychelles.

Cultivation. In cultivation the tree is grown as a bush,* seed being sown *in situ* about 8 in. apart, in circular clusters about 4 ft. in diam., these being spaced by about 10 ft. from centre to centre. The seeds take about 3 weeks to germinate. Long, straight, clean shoots are thus produced. The plant thrives in deep alluvial sandy soil, from the sea-coast to about 2,000 ft., with an average rainfall of not less than 80 in.

HARVESTING CINNAMON (*Cinnamomumzeylanicum* IN CEYLON.

Harvesting. When the shoots have attained the thickness of one's finger and a height of 6–8 ft.—*i.e.* about 2 years from sowing—they are cut close to the ground in order to obtain the bark. Cutting is done when growth is active and the bark easily removed, *i.e.* after rainy weather has set in, usually in May–August and October–December in Ceylon. The bark will not readily peel in dry weather. The peelers, sitting in rows at distances of about 3 ft. apart, make a longitudinal slit along the length of the stem and a parallel slit on the opposite side; the bark is then raised with the point of a curved knife, peeled off in strips, then placed in a heap and covered with sacks so as to undergo slight fermentation. The following day the outer skin of the bark is scraped off with the same knife, the peeler placing the bark along a smooth stick which is held in position with the aid of his or her toes. The bark being then placed in the shade for a day or two for partial drying, it contracts into quills, which are finally dried in the sun. The end of one quill is then placed inside another, thus forming smooth cane-like quills about 3 ft. long which, when dry, are of a pale brown colour. They are then made up into bales of about 60 lb. each, and wrapped with hessian for export.

Yield. About 50–60 lb. of quills per acre may be expected from the first crop 3 or 4 years after planting, the yield increasing until about the tenth year, when the maximum crop of 150 to 200 lb. may with good cultivation be obtained. Some 41,300 cwt. "quills," 7,500 cwt. "chips," and 163,732 lb. cinnamon oil (from leaf and bark) were exported from Ceylon in 1933.

* In season June–July.

PEELING CINNAMON BARK.

Uses. The spice is largely used for flavouring, and quoted in London at about 1*s*. 2*d*.–1*s*. 6*d*. per lb., according to grade. *Chips* and *featherings*, which are the waste from peeling, are used for the distillation of *Cinnamon oil*, largely employed in medicine, while *broken quills* go to make "ground cinnamon" or "mixed spice." The leaf- and bark-oils are extracted locally by distillation, the latter being the more valuable and usually quoted at about 5*s*. to 6*s*. per lb. A fat obtained from the fruit was formerly used for candles in churches.

Varieties. Several varieties are recognised by the Sinhalese, as Peni-, Rasa-, Pengiri-, Tittha- and Kahata-kurundu, all signifying special qualities of the bark. The value of the latter, however, appears to be chiefly dependent on soil, climate, cultivation, etc. "Tazpat," the Indian name for *Cinnamomum Tamala*, a medium-sized tree of the Himalayas, cultivated in the Khasia Hills, etc. for the leaves or bark, which is also sometimes known as "Indian Cassia-lignea." Both leaves and bark are used medicinally and for flavouring, but are of local importance only. *Cinnamomum Culilawan*, a medium-sized tree of Amboyna, with small leaves and aromatic bark, the flavour of which is considered to resemble that of cloves; introduced to Ceylon in 1870.

CLOVES (*Eugenia caryophyllata*). *Left:* green cloves (flower buds) and, lower, dried brown cloves.

Clove (from French *clou*, a nail); Karabu or Karabu-netti, *S* and *T*. (*Eugenia caryophyllata*. Myrtaceae.)—A small conical tree, 25–30 ft. high, native of the Moluccas, introduced into most tropical countries. It was established in Ceylon before the arrival of the British in 1796. The cloves are the dried unexpanded flower-buds, which are picked green, usually during January in Ceylon, and spread in the sun for a few days to dry, when they become dark brown.

Cultivation and yield. The tree likes a deep, rich loamy soil on sloping land, and thrives up to 2,000 ft. It is propagated by seed, which takes 5–6 weeks to germinate. The seedlings, which are of very slow growth, may be planted out when about 12 in. high, at distances of about 20 ft. apart each way, *i.e.* at the rate of 100 plants per acre. The first crop may be obtained when the trees are about 8 or 9 years old, the yield increasing until they are about 20 years old, when an

average of 8–10 lb. or more dried cloves per tree may be procured. Zanzibar and Pemba furnish about 90% of the world's supply of cloves, and about half of the crop goes to India. Small quantities are exported from Ceylon.

MADAGASCAR CLOVE (*Ravensara aromatica*). Showing unripe fruit, used as a spice.

Clove oil, obtained by distillation from the leaves and unripe fruit (known as "Mother of Cloves"), also from broken cloves and stalks, fetches about 10*s*. per lb. It is used for various scientific purposes and for artificial vanillin (*q.v.*). "Essence of Cloves" is formed by diluting Clove oil in the proportion of 4 oz. to 2 quarts of spirits. Cloves were known to the Chinese in 266 B.C., when officers of the Court were required to hold cloves in their mouths when addressing the Sovereign. The spice was imported into Europe in 1265 and valued at 10*s*.–12*s*. per lb. When the Dutch obtained control of the Spice Islands from the Portuguese, they formed a monopoly of the spice and confined its cultivation to Amboyna. In 1609 a shipment of 112,000 lb. of cloves was brought to England on which £1,400 was paid as duty and a similar sum as tax. The market price in London varies from 6*d*.–8*d*. per lb. for Zanzibar cloves, to 10*d*. or more for "Fine Penang."

Madagascar Clove, or Clove-nutmeg. (*Ravensara aromatica*. Lauraceae.)—A medium-sized tree, 30–40 ft. high, with small leathery leaves, native of Madagascar, introduced to Ceylon in 1847. The whole tree is strongly aromatic. The round fruits, of the size of marbles, have each a large, hard kernel, which is considered to combine the flavour of nutmeg and clove. It is used locally as a spice, and is sometimes exported, chiefly to France. The tree is propagated by seed, and is suited to the moist low-country under 2,000 ft.

GINGER (*Zingiber officinale*). Showing rhizomes, which form the spice.

Brazil Clove. (*Dicypellium caryophyllatum*. Lauraceae.)—A Brazilian tree, the "cloves" of which are said to be remarkable for their fine aroma, being largely employed in Brazil for flavouring as well as for medicinal purposes. The bark and wood furnish an essential oil known as "Clove Cassia," or "Clove bark-oil," for the extraction of which they are imported into France.

Galangal. There are two forms of the plant known by this name, *viz.* Lesser Galangal (*Alpinia officinale*) and Greater Galangal (*A. Galanga*), both herbaceous perennials of the Ginger family. They rather resemble ginger, and have long been known as a spice and in medicine. The latter plant is cultivated in Java and Malaya, being commonly used for flavouring curries, etc.

Ginger; Inguru, *S*; Inji, *T*. (*Zingiber officinale*. Scitamineae.)—A herbaceous perennial, with leafy shoots which grow to a height of about 2–3 ft. Though supposed to be a native of Trop. Asia, its original home is uncertain, since it has long been cultivated in all tropical countries and is nowhere found in a wild state.

Curing, etc. The underground tuberous stems (rhizomes), resembling thickened roots, are the ginger of commerce. These are called "hands" or "races," from their palmate shape, and are exported in two forms, *peeled* and *unpeeled* ginger, *i.e.* uncoated and coated respectively. The former is prepared by scalding the tubers

in hot water, then removing the epidermis with a narrow-bladed knife. Unpeeled or coated ginger (*i.e.* not deprived of the epidermis) is merely washed, and then dried in the sun. The rhizomes are exported in bags or barrels, and are usually valued in England at from 40*s.* to 80*s.* or more per cwt., according to quality and demand. "Bold Jamaica" commands the highest price, Calicut or Cochin sorts coming second, and Japanese and W. African generally third. The latter country is now the largest exporter of ginger, superseding India, which once led the market. Jamaica, once known as the "Land of Ginger," has long been famous for the product.

Cultivation and yield. The plant requires an equable hot and moist climate, a shaded situation, a rich, well-tilled, humous or loamy soil, and thrives up to about 3,000 ft. It is propagated by division of the tubers or rhizomes, which are planted about 18 × 12 in. apart, in rows. Ginger seed is unknown. Manuring is essential, and in dry weather occasional irrigation may be necessary. A harvest is yielded in about 9 months from planting, when the leaves begin to wither, the average return of dry ginger per acre, under favourable conditions, being variously estimated at between 1,000 and 2,000 lb. Ginger has long been highly valued for medicinal purposes, more especially in England. It is also esteemed in preserves, confectionery, and in the manufacture of ginger beer, etc. *Preserved ginger* is prepared largely in China, where the plant is extensively cultivated, both for local consumption and for export.

Grains of Paradise ; Guinea Grains, Guinea Pepper, or Melegueta Pepper. (*Amomum Melegueta.* Scitamineae.)—A herbaceous, bushy perennial, 5–6 ft. high, with arching leafy shoots, allied to the Ginger, native of W. Trop. Africa. The flowers and fruit are produced on long, trailing, cord-like runners or racemes, which grow from the base of the plant. The small dark-brown aromatic seeds, enclosed in an ovoid fruit 2–2½ in. long, constitute the spice and are exported from the Gold Coast, Nigeria, etc., being used chiefly in veterinary medicine; also sometimes for flavouring cordials, spirits and wine. At one time they were in considerable demand and largely exported, being used as a substitute for pepper. They are largely employed by the natives of W. Africa for seasoning their food. Some considerable quantity of the spice is exported annually, chiefly to England, being valued at about 60*s.* per cwt. The Pepper Coast of Guinea is supposed to take its name from this spice.

Mace ; Wasa-vasi, *S* ; Poollie, *T.*—An important spice, consisting of the net-like wrapper (*aril*) surrounding the nutmeg, inside the husk (see *Nutmeg*). At first crimson-scarlet, it becomes yellowish-brown on drying and exposure, and is much esteemed in confectionery and for culinary purposes. The proportion of mace to nutmeg is about one-fifth by weight; 100 nutmegs should produce about 3 oz. dried mace. The latter is valued chiefly on the brightness of its colour, which slow drying in the shade helps to preserve. *Fine Red*, the best quality, is usually quoted at about 2*s.* 6*d.* per lb. At one time the duty on mace in England was 7*s.* per lb.

Massoi- or Meswi-bark. (*Massoia aromatica.* Lauraceae.)—The aromatic bark, obtained from a large tree in New Guinea, is an article of commerce in the Far East, and an oil from it has the odour of cloves and nutmeg. The tree is not cultivated.

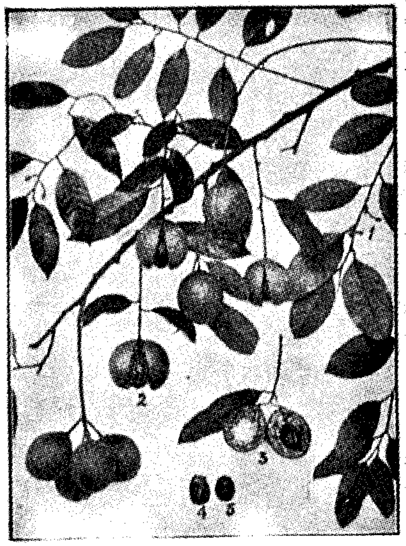
Nutmeg ; Sadhika, *S* ; Sadhi-kai, *T.* (*Myristica fragrans.* Myristicaceae.)—A medium-sized or large tree, sometimes 70–80 ft. high, native of the Moluccas, introduced to Ceylon about 1804 and often met with in low-country gardens. The nutmeg of shops is the hard, brown, ovoid kernel, which is enclosed in a thin brittle shell, immediately surrounding which is the scarlet aril or mace in the form of a net (see *Mace*); next to this is the large, thick, fleshy and juicy husk. The pale amber whole fruit resembles a large apricot. When ripe, *i.e.*, about 5–6 months after flowering, the husk splits open and discloses the glossy, dark-brown nut (seed) almost surrounded by the mace, as already stated.

The fruit is then picked, or the nuts are allowed to drop to the ground and then collected. They are separated from the mace, and either dried separately in the shade or on shelves in heated sheds.

For export, the nuts must be dried thoroughly, so that the kernel rattles in the shell. Dusting them with dry powdered lime has the effect of preventing their going mouldy. The nuts are graded for export; 60–120, according to size, go to 1 lb., fetching in London from about 10*d.* per lb. for the smaller size to about 1*s.* 2*d.* for the larger.

Nutmeg Butter, obtained from damaged or whole nuts and used for scenting soaps, etc., is quoted at about 4*s.* per lb. The nut itself, carried on one's person, is a reputed cure for lumbago and rheumatism.

Cultivation and yield. The tree thrives best in deep loamy and well-drained soil, in a hot and moist climate, up to 2,000 ft. elevation. When young, it is benefited by light shade from thinly planted shade-trees, as Dadap or Gliricidia. Being usually dioecious, it is impossible to distinguish the sex of a tree until it flowers. Therefore when planting, it is necessary to make allowance for cutting out excessive males, as by halving the normal spacing or by placing 2 plants to each hole, 2 ft. or more apart. This allows for at least 50 per cent. removals. The proportion of one male to 10 or 12 female trees (or 8 males to an acre) should be sufficient to ensure the pollination of the latter. The trees come into bearing at the age of about 8–9 years, bearing at first only a few hundred fruits each; they increase in yield until about 30 years old, when the average crop may be about 3,000 to 4,000 nuts per tree a year, though some trees may bear as many as 8,000 or more. They produce two main crops, which spread over the greater part of the year, and continue productive for very many years. Trees about 90 years old, in Peradeniya Gardens, Ceylon, bear heavy crops annually, chiefly in June–August and October–December.



NUTMEG (*Myristica fragrans*).
1, flower; 2, fruit opening and showing nut covered with scarlet mace; 3, fleshy fruit as it splits open, showing nut on right; 4, mace-covered nut; 5, nut deprived of mace.

Propagation is usually from seed, which take about 3 months to germinate. Sow in boxes under cover, or in a well-prepared bed in a moist, shady corner; cover the seeds with an inch of fine soil, and water daily in dry weather. When the seedlings are large enough to handle, transfer them to baskets or bamboo pots, and plant out in permanent positions when about 12 in. high, at distances not less than 26 ft. each way. Owing to the uncertainty of the proportion of male to female plants when raised from seed, propagation by grafting ("inarching") is recommended. Old trees sometimes become monoecious (bearing both male and female flowers) and therefore fruit-bearing.

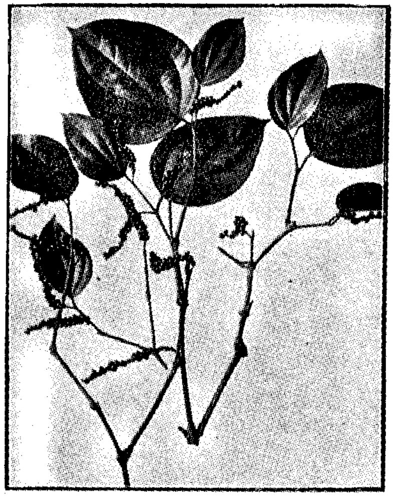
The principal sources of nutmegs are the Moluccas and Celebes Islands. A considerable quantity comes from the W. Indies, especially Grenada, where the trees are often interplanted with cacao. The cultivation has much decreased in Ceylon since the advent of rubber, the export of nutmegs from that country in 1933 being given as 839 cwt., valued at £650, = about 15*s.* 6*d.* per cwt. Penang nutmegs usually command the highest price.

Calabash Nutmeg (*Monodora Myristica.* Anonaceae.)—A small tree of W. Trop. Africa, with large oval leaves and scented flowers, introduced to Ceylon in 1897. The large globular fruit contains a number of aromatic seeds, whose odour and flavour

are considered to resemble those of the nutmeg proper. The tree is suited to the moist low-country, and thrives in any moderately good soil.

Other so-called nutmegs are: Brazil Nutmeg (*Cryptocarya moschata.* Lauraceae); Clove Nutmeg (see *Madagascar Clove*); Papua Nutmeg (*Myristica argentea*), and the Wild Nutmeg of India and Ceylon (*Myristica laurifolia*). The last named, a large tree with spreading branches and long, lanceolate, oval leaves, common in Ceylon from 1,000 to 5,000 ft., bears an oblong-ovoid nut, about 1½ in. long, furnished with orange-yellow mace, is of no commercial value.

Pepper; Gammiris, *S*; Molavu, *T*. (*Piper nigrum.* Piperaceae.)—A creeping perennial vine, indigenous to the moist low-country forests of Ceylon, S. India and Malaya. Both "black" and "white" peppers are the product of the same plant. The berries (peppercorns) when of a reddish colour are picked and spread on mats in the sun, when they become black and shrivelled. Dipping them first in boiling water hastens the drying. When ground with the outer covering left on they form "black pepper"; deprived of this covering, as by soaking in water for a week and then trampling upon it, "white pepper" is obtained. A decorticating machine is sometimes used for the purpose, and this more effectively removes the outer covering. The use of pepper as a spice dates from very early times, being mentioned by Theophrastus in the 4th century B.C. In the middle ages it was very highly valued, and Venice, Genoa, etc. owed much of their wealth to the trade in this spice.



PEPPER (*Piper nigrum*). Showing spikes bearing pepper-corns.

Cultivation. The pepper-vine requires moist heat with shade, an evenly distributed rainfall, and thrives up to about 2,000 ft. Artificial or natural supports, in the form of tall posts or trees, are necessary, the latter being preferable and more durable. Erythrina, Mango, Jak, Kapok, and other quick-growing trees form suitable live supports, while they also provide a beneficial light shade. In Sumatra and Malaya, trellises of some hard and durable wood are often used for supports. The most economical method is to grow the vines on trees which are used for shade, as along roadsides or amongst crops. Propagation is by cuttings, which should be about 18 inches long and selected from the ends of the best bearing vines. These may be either started in a nursery bed, or planted out where they are to remain. 2 or 3 may be planted to each support. The vines grow from 8 to 20 ft. or more in length, according to the nature of the supports, and if carefully treated may continue to bear for 20 years or longer. Often, however, it is necessary to renew them after 12 or 15 years of cropping.

Yield, etc. A small crop may be expected in the third year from planting, but the vines will not be in full bearing till the sixth or seventh year. In India, Malaya and Ceylon, the main crop is produced usually from March to May, and a smaller crop in August or September. The yield varies considerably. With good cultivation a crop of about 1,000 to 1,500 lb. or more per acre may be obtained, allowing for the plants to be spaced about 7 × 7 ft. The small berries (peppercorns) are borne on slender spikes 3–6 in. long, and each full-grown vine may yield from 3 to 5 lb. dried pepper annually. "Lampong" (black pepper) is now (1935) quoted at about 4*d*., while "Muntok" (white pepper) fetches about 9*d*. per lb. The chief sources of supply are the Straits, Java, Sumatra, Malabar and Ceylon. The latter's annual export varies from about 1,500 to 3,500 cwt.

Cayenne Pepper is a trade name for pulverised red chillies, with possibly an addition of pepper and certain other spices.

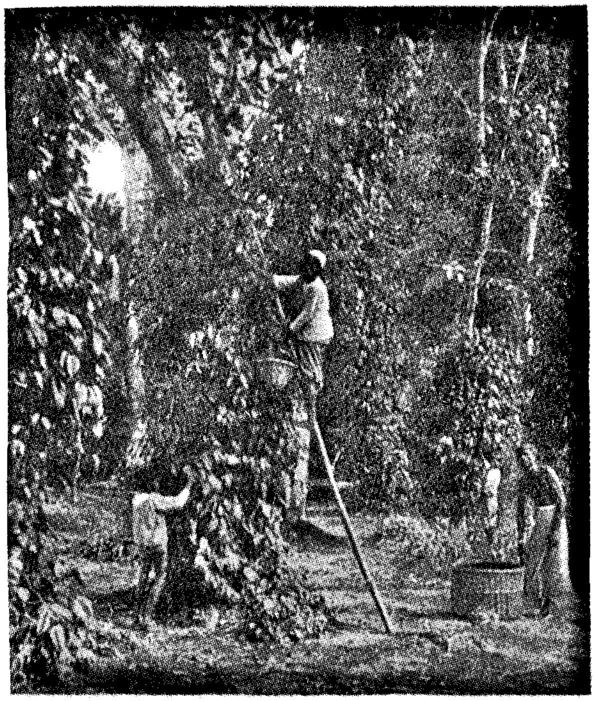
Long Pepper. This consists of the unripe fruiting spikes of *Piper longum*, dried in the sun. The plant is a native of India and Ceylon, and is cultivated in parts of India. The pepper is used chiefly in medicine, being less pungent than *P. nigrum*.

Japanese Pepper. (*Zanthoxylum piperitum.* Rutaceae.)—A deciduous tree of Japan, the black, aromatic, pungent fruits of which resemble peppercorns and are used as a spice in Japan and China.

Ashantee Pepper. (*Piper Clusii.* Piperaceae.)—An ornamental pepper-vine of W. Trop. Africa, where the corns are employed as a condiment. These were at one time exported to Europe for use as a spice. The plant is not cultivated.

Negro Pepper, Guinea-, Kimba- or W. African Pepper. (*Xylopia aromatica.* Anonaceae.)—A shrubby tree, native of W. Africa, producing clusters of pod-like fruits about 2 in. long. These are aromatic and pungent, and are used locally in a dried state as a spice.

Pepper-tree. *Schinus molle.* An ornamental shrubby tree, the small pungent berries of which are sometimes used as pepper in S. Africa, etc. (*Q.v.*)



GATHERING PEPPER FROM PEPPER-VINES ON *Erythrina indica* IN CEYLON.

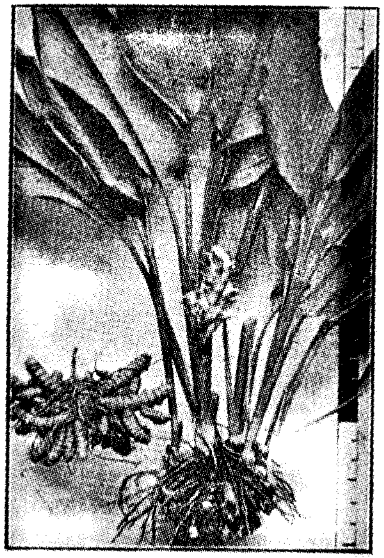
Star-Anise. (*Illicium verum.* Magnoliaceae.) — A shrub or small tree of S. China, where it is cultivated commercially. The fruit consists of several carpels, which when ripe open out in the form of a star. It is agreeably fragrant and aromatic, and in China and Japan is used as a spice in cookery. It is also esteemed as a digestive and breath-sweetener. An oil distilled from the leaves is used in medicine and for flavouring liqueurs and spirits, as in "Anissette de Bordeaux." It is quoted in London at about 3*s*. 6*d*. per lb. Seeds imported to Ceylon on different occasions have always failed to germinate. It is said that the Chinese boil the seed before it leaves the country, so as to maintain the monopoly of the spice. The fruit of *I. anisatum* furnishes the Japanese Star-Anise.

Tonka Bean. (*Dipterix odorata.*)—The fragrant seeds are used for flavouring, a

" tincture of tonka " being sometimes employed by pastrycooks and confectioners as a substitute for vanilla. (See *Perfumes.*)

Turmeric ; Kaha, *S.* (*Curcuma domestica = C. longa.* Scitamineae.)—A perennial herb, 2–3 ft. high, cultivated throughout Trop. Asia. The tuberous rhizomes are of a bright orange-yellow colour and waxy resinous consistency; they are ground into a fine powder, which has an aromatic flavour, somewhat resembling ginger. This is commonly used as a condiment in cookery, more especially in the tropics, and is a prominent constituent of curry powders; it is also employed in India for dyeing wool and silk.

Cultivation and yield. Turmeric is cultivated largely in India, Formosa, etc., for export. It is quoted in London at from about 16*s.* to 22*s.* per cwt., Madras turmeric usually fetching the highest price. The plant is propagated by the rhizomes or by division of the crown, and is suited to open, friable soil, under partial shade; it thrives in a hot and moist climate up to about 3,000 ft. Under favourable conditions an annual yield of 28–40 cwt. per acre may be obtained. Cultivation is much the same as for Ginger, and a crop may be produced in about 9 months from planting. The rhizomes should be dug up as soon as the stems fade. They are prepared for market by drying in the sun, being usually scalded in hot water to check or destroy their vitality and thereby prevent sprouting.



TURMERIC (*Curcuma domestica*). Showing flowers and rhizomes.

Vanilla. (*Vanilla planifolia.* Orchideae.)—A large, creeping orchid with long, elliptic, fleshy leaves, native of Mexico, introduced to Ceylon in 1847. Vanilla Beans are the dried and cured pod-like fruits, which have long been esteemed for flavouring purposes, and were used by the Aztecs before the discovery of America. *Vanillin*, the active principle of vanilla, has in recent years been produced synthetically, and this has resulted in making Vanilla cultivation a precarious occupation. The spice fluctuates considerably in price according to demand, ranging from 6*s.* or 8*s.* to as much as 70*s.* per lb. The latter figure was quoted in London in 1924. It is, however, as a subsidiary crop or as an occupation for women that vanilla is to be recommended, for it involves but little labour and outlay. One of the chief uses of the spice is for flavouring chocolates. It is also used by perfumers and for scenting tobacco.

Cultivation. The vine thrives in a hot and humid climate, from sea-level to about 2,000 ft. It requires light chequered shade, protection from strong wind, and support by means of low trees, trellis or fence. Live supports are the best, and among the most suitable are the Physic-nut (*Jatropha Curcas*), Calabash Tree (*Crescentia Cujete*), Dadap (*Erythrina*), and the Temple Tree or Frangipani (*Plumeria*). Low-branching trees with sparse foliage and rough bark are recommended.

Propagation is by cuttings about 3 or 4 ft. in length, which are planted *in situ.* Two cuttings are placed against each support, on opposite sides; the lower ends are covered with some surface soil or humus, the rest of the cuttings being tied to the supports, and then watered. Some recommend leaving the lower end of the cutting exposed so as to avoid the risk of decaying. Spacing may be about 8 × 8 ft. for supports with vines. The cuttings soon develop aerial clinging roots, after which the plants require but little attention beyond weeding and regulating shade. The minute black seeds are usually sterile. (See *Orchids.*)

Pollination.—The vines begin to blossom about 15–18 months after planting, and a small crop may be obtained about 9 months later. The principal flowering season in Ceylon is April–May; in Malaya it is September–November. In the wild state the flowers are fertilised by bees and humming birds; but in cultivation it is necessary to pollinate or " marry " the flowers by hand, as otherwise few if any will set fruit. Self-pollination is impossible, owing to the structure of the fls. The pollinating process must be done in the morning, while the pollen masses and the receptive stigma are fresh. It consists in lifting the 2 adhesive pollen masses (*pollinia*) on a small piece of pointed stick and bringing these in contact with the viscid stigmatic surface, under the *rostellum.* An expert can pollinate from 700 to 800 or more flowers in half a day. Not more than 6–7 fls. in a cluster should be fertilised, and a vine should not be made to bear more than about 30 pods, half that number being sufficient for a weak plant. The smooth cylindrical pods are ready for picking when a slight yellowing appears at the ends. In heavily shaded situations the pods take longer to mature.

VANILLA (*Vanilla planifolia*). (1) Full grown pods.

Curing is usually begun by dipping the pods into almost boiling water for about 25 seconds, after which they are alternately placed between blankets to " sweat," and in the sun to dry. In order to induce fermentation they are then rolled up in a blanket and placed in a closed box, being taken out each day and spread in the sun for one or two hours; this process may be continued for about 14–20 days or more, when the pods will have become brown and pliable. The method of curing, however, varies somewhat in different countries. In Seychelles, the pods are spread on trays in a heated room, with a temperature of say 90° to 100° F., and afterwards placed between double blankets. This takes longer than the former method. The pods (" beans ") are afterwards treated in a cooler temperature, being occasionally squeezed and drawn through the fingers, so as to render them pliable. It is considered that the more slowly vanilla is cured the better. When the curing is complete, *i.e.* in about 3–5 weeks after picking, *vanillin* accumulates as a coating of fine crystals on the pods; the absence of this crystallisation depreciates the value of the spice, so that care must be taken to preserve it. Pods which are inclined to split should be tied up at the ends with a piece of fine thread.

Grading. The pods are then graded according to lengths, made up in 1-lb. packets, and packed in soldered tins for export. Of pods 7 in. long, about 110 should weigh a pound; pods 8 in. long, 80 = 1 lb.; 9 in. long, 66 = 1 lb. The standard size of boxes used in Seychelles for exporting vanilla is 13 in. long, 9 in. broad, and 6 in. deep. A lining of silver paper or tin-foil being placed in the box, the pods are packed fairly loosely, and the lid then soldered down.

Yield. An acre of good, healthy vines (say, 600 trees or supports) may give a yield of about 110 lb. of cured pods. The yield per acre in Hawaii has been estimated to approximate 13,000 pods or about 150 lb. of cured beans. In Seychelles, however, 8,000 pods to the acre, equalling about 100 lb. of cured vanilla, is considered a good average yield. The chief countries of production are Mexico, Tahiti,

Réunion, Madagascar and Seychelles. The export of vanilla from Ceylon for 1933 is given as about 50 cwt., valued at over £150.

Diseases. Excessive shade, over-crowding and heavy cropping are all liable to weaken the vines and predispose them to disease. Perhaps the most serious fungus disease to which the Vanilla plant is subject is *Calospora Vanillae*, which has proved so destructive to the Vanilla industry in Seychelles.

Vanillon or **Vanilloes.** (*Vanilla pompona.*)—A native also of Mexico, yielding an inferior quality of vanilla known by the name of Vanillon or Vanilloes. This is claimed, however, to have certain advantages over Vanilla proper, as its pods, which are short and thick, are not so liable to split at the ends, while the vines are said to flower and fruit more or less throughout the year.

Vanilla Essence. According to the *Journal of the Jamaica Agricultural Society*, this product has been prepared in Jamaica from vanilla beans and sold at 20*s.* per gallon, which is said to be equivalent to 10*s.* 6*d.* per lb. for cured beans.

Synthetic Vanillin. Notwithstanding the introduction of this article, there is still a large and remunerative demand for Vanilla, which is esteemed for flavouring confectionery, and in perfumery, etc. There is said to be a reluctance on the part of manufacturers to use the former, more especially since the introduction of legislation in France and the United States restricting the use of synthetic food products. Artificial vanillin was first made about 1891 from eugenol, obtained from the oil of cloves; but other processes have since been discovered for its manufacture, including the utilisation of certain coal-tar products.

Winter's Bark. (*Drimys Winteri.* Magnoliaceae.)—A small tree of temperate S. America, the bark of which is aromatic and sometimes used as a spice and in medicine. The tree has been established at Hakgala Gardens, Ceylon.

Zeodary. (*Curcuma Zerumbet.* Scitamineae.)—A herbaceous perennial, resembling Turmeric, the aromatic rhizomes of which have long been used as a spice and in medicine. It is still cultivated in India to some extent, being used medicinally as well as for seasoning curries, etc., also as a dye.

CONDIMENTS AND SEASONING HERBS

Aniseed; Maha-duru, *S.* (*Pimpinella Anisum.* Umbelliferae.)—An annual, cultivated in S. Europe for its small seed-like fruits, which are much used in confectionery, cookery, and in the manufacture of a well-known cordial. The leaves also may be used for flavouring and for garnishing. The plant requires a light, rich soil, and may be grown from seed sown broadcast, or in drills 12 in. apart. Suited to a rather dry climate; commonly grown on the plains in India. Aniseed is now quoted at about 40*s.* per cwt. in London.

Basil, Sweet; Suwanda-tala, *S*; Tulsi, of India. (*Ocimum Basilicum.* Labiatae.)—An annual, about 2 ft. high, native of and commonly cultivated in India, Burma, etc., for its yellowish-green essential oil. The plant is often met with in peasants' gardens in Ceylon. It is cultivated in Europe and elsewhere for its highly fragrant and aromatic leaves, which are used for flavouring soups, etc., but their strong odour is disagreeable to many persons. The plant is sacred to the Hindus, and is commonly cultivated near their temples. Thrives best at low and medium elevations. (See *Essential Oils*, also *Perfumes.*)

Caraway; Shimai-shombu, *T.* (*Carum Carvi.* Umbelliferae.)—A biennial, native of S.E. Europe, 2–3 ft. high, cultivated chiefly in Holland, and to some extent in Morocco, etc., for its small, brown and well-known aromatic "seeds" (fruits), which are much used in confectionery, also for flavouring liqueurs, perfuming soap, etc. It does not seem to be suited to the tropics. The seed may be sown broadcast, or in drills about 12 in. apart. It is quoted at about 35*s.* per cwt. in London, and Dutch Caraway-oil at about 9*s.* per lb.

Caraway, Black. (*Carum nigrum.*)—A form with dark "seeds," cultivated and valued chiefly in N. India. **Carum copticum,** Ajwan or Ajowan. (See *Thymol.*)

Chervil. (*Anthriscus sylvestris.* Umbelliferae.)—An annual herb, native of Europe, the young leaves of which are sometimes used in salads and for flavouring purposes. Suited to the higher elevations in the tropics. Sow seed broadcast on a bed with a smooth surface.

Chives. (*Allium Schoenoprasum.* Liliaceae.)—A small bulbous perennial, cultivated for its pungent, fine filiform leaves, which are used in salads and soups instead of young onions, being less pungent than the latter. It is propagated by seed or division of the roots. The plant is suited to dry or moist districts, but is little known in India or Ceylon.

Clary. (*Salvia pratensis.* Labiatae.)—A small herbaceous biennial, the leaves of which are sometimes used for flavouring soups, etc. Seed may be sown in drills about 16 in. apart, or in boxes, the seedlings being afterwards transplanted at distances of 12 × 10 in. Sometimes grown in hill gardens.

Coriander. (From Greek *coris*, a bug, in reference to the odour of the unripe fruit.) Kotthamallie, *S.* (*Coriandrum sativum.* Umbelliferae.)—An annual herb, similar to Caraway, commonly cultivated in N. India, Asia Minor, Morocco, etc. The seed is used for the extraction of a volatile oil, also in confectionery, curry powder, "mixed spice," and in medicine as a carminative and stimulant. It is usually quoted at from 30*s.* to 45*s.* per cwt. in London. The leaves are used for flavouring curries and soups. Succeeds in ordinary soils; usually grown in India as a mixed crop, the seed being sown broadcast. A yield of about 300–500 lb. per acre may usually be obtained. Coriander is mentioned in the Bible.

Cumin; Sudu-duru, *S*; Seerugam or Shiragam, *T.* (*Cuminum Cyminum.* Umbelliferae.)—An annual, 2–3 ft. high, with Fennel-like, feathery leaves, and "seeds" (fruits) like Caraway, but slightly larger and lighter in colour than the latter. It has been cultivated in Egypt and Palestine from very early times, and is mentioned in the Old and New Testaments. Cumin has properties similar to those of Caraway and Dill, and at one time largely took the place of these as a condiment, in medicine, etc. It is still so employed in Europe, and very largely imported into S. America, where it is said to take precedence over all other condiments. It is also imported into India, Ceylon, Straits, etc., and sold everywhere in the bazaars or boutiques as a condiment. Apparently it is nowhere cultivated in the tropics, the chief sources of production being Malta, Persia, Turkey and Morocco, though it is also grown extensively in N. India. The seed is now quoted in London at from 50*s.* per cwt., and cumin essential oil at about 15*s.* per lb.

Black Cumin; Kalu-duru, *S.*—Is the seed of *Nigella sativa* (Ranunculaceae), an annual herb, native of Levant, cultivated in parts of India for the seed, which is aromatic, carminative and stomachic, and usually quoted at about 27*s.* per cwt.

Dill; Satha-kuppai, *T* & *S.* (*Peucedanum graveolens.* Umbelliferae.)—A small annual of the Mediterranean region, the aromatic leaves of which are used in soups, sauces, etc. The pungent seeds are used in curry powders, and yield an essential oil of medicinal value, from which the well-known Dill-water for infants is made. The plant is cultivated in Asia Minor, N. India and N. Africa. Seed may be sown broadcast or in drills. Dill seed is quoted in London at about 22*s.* per cwt., and Dill-oil at about 26*s.* per lb.

Fennel; Enduru, Divi-duru, Maha-duru, or Bata-enduru, *S*; Perumseeragam, *T.* (*Foeniculum vulgare.* Umbelliferae.)—A perennial herb, native of S. Europe, commonly grown in gardens in all warm countries. In North-Western India it is commonly met with in a wild or cultivated state. The fruits are used for the extraction of a volatile oil valued in medicine, etc. The tall, finely-divided, aromatic leaves are used in fish sauces and for garnishing, but have an overpowering odour; the leaf-stalks are relished by some in salads, and the furrowed ovoid fruit in confectionery and for flavouring liqueurs. Indian Fennel seed is quoted in London at about 30*s.* per cwt. The plant thrives best in moist situations, being suited to medium and high elevations. Seed may be sown in beds of well-prepared soil.

Fenugreek; Ulu-hal or Asumodhagam, *S*; Uluva-arisi, Mathai or Vendayum, *T*; Mathi, Channi Rajani of India. (*Trigonella Foenum-graecum.* Umbelliferae.)—An annual, largely grown in India for the small, brown, grain-like, aromatic fruits, which are largely used as a condiment and in curry stuffs; they are also used in medicine, and yield a yellow dye. Seed is sown broadcast at the rate of about 20 lb. per acre. The crop ripens in 2½–3 months after sowing. Quoted at about 14*s.* per cwt.

Garlic; Sudu-lunu, *S*; Vella-vengam, *T.* (*Allium sativum.* Liliaceae.)—A bulbous-rooted perennial, native of Central Asia and naturalised in S. Europe; much cultivated in India and the East generally for its small, white, onion-like bulbs, which have a pungent flavour and an overpowering odour. These are sometimes used in Europe for flavouring soups, stews, etc. In India, Ceylon and other tropical countries they are largely used in native cookery and medicine. The plant will thrive almost anywhere on the plains or hills, but succeeds best in light, rich and friable soil. It is commonly cultivated in native gardens in Ceylon, but the market supplies are imported principally from India. Propagated by the bulbs.

Horse-radish. (*Cochlearia Armoracia.* Cruciferae.)—This well-known season-

ing plant is commonly grown in hill gardens in the tropics, but is quite unsuited to the plains or low elevations. The bitter tuberous roots, scraped or grated, are used in soups, sauces, etc. The plant is propagated by division of the rootstock with a portion of the crown attached, and thrives best in a deep, rich and rather moist soil. Deep holes may be made about 18 in. apart and filled with well-manured soil, into which setts are planted a few inches deep. The roots should be ready for use in 4 or 5 months afterwards.

Horse-radish Tree; Murunga, *S.* (*Moringa pterygosperma.* Moringeae.)—A small tree, the main thick root of which is commonly used throughout India as a substitute for horse-radish, to which, however, it is much inferior in flavour. The long, pendulous pods, produced chiefly in March and April, are very generally consumed by the natives in an unripe state as a curry vegetable.

Hyssop. (*Hyssopus officinalis.* Labiatae.)—An aromatic dwarf shrub, native of Asia Minor, cultivated in European gardens. The leaves are sometimes used for flavouring as well as in medicine. Propagated from seed and thrives in light rich soil; suited only to the hills.

Karapincha, *S*; Karavempu, *T*; Curry-leaf. (*Murraya Koenigii.* Rutaceae.)—A small tree of the Orange family, native of Ceylon and found chiefly in the dry region. It is familiar as the Curry-leaf, the pungent aromatic leaves being a common ingredient in curries, mulligatawny, etc. The tree prefers light rich soil, and with cultivation will thrive up to at least 2,000 ft. Propagated by seed, which are in season chiefly in April–May.

Lavender. (*Lavendula vera.* Labiatae.)—A dwarf shrub, native of S. Europe, commonly grown for its pleasantly scented flowers. The aromatic leaves are sometimes used in seasonings. The plant thrives in the hills, flowering and seeding freely.

Lemon Grass; Sayra or Sereh, *S.* (*Cymbopogon citratus.*)—The white fleshy swollen part of the leafy stalks of this well-known fragrant grass, cultivated chiefly for the oil obtained from the leaves, is very generally used by the peasants of Ceylon for flavouring curries, being also sometimes used in pickles. The stalks are commonly sold in the markets and boutiques at ½ cent each. (See *Essential Oils.*)

Marigold, Pot. (*Calendula officinalis.*)—An annual of S. Europe, commonly grown as an ornamental flowering annual. The showy flowers are edible and sometimes used for flavouring soups, etc., and an extract from them is said to possess stimulant properties. (See *Flowering Annuals.*)

Marjoram, Sweet. (*Origanum vulgare.* Labiatae.)—An annual herb, native of N. Africa, cultivated in European gardens for its fragrant and aromatic leaves, which are used for flavouring purposes. Propagated by seed and is adapted to hill gardens.

Marjoram, Pot. (*Origanum Onites.*)—A perennial seasoning herb, native of Sicily. Propagated by division of the roots.

Mint; Spearmint; Meenchi, *S.* (*Mentha viridis.* Labiatae.)—A small herbaceous perennial with creeping rhizomes; one of the most valuable of all seasoning herbs and a universal garden plant in temperate countries, as well as in hill gardens of the tropics, where it often becomes semi-naturalised. It prefers moist humous soil, and in partial shade will thrive even at low elevations. The tops and young leaves are used for flavouring in numerous ways, as in soups, salads, and sauces, or boiled with peas, potatoes, etc. Easily prop. by root division or rhizomes.

Country Mint; Odu-talan, *S.* (*Mentha javanica.*)—A small herb, 1–2 ft. high, closely resembling the above in appearance and scent, found at low and medium elevations in the tropics. See *Peppermint*, also *Spearmint Oil.*

Mustard; Aba, *S*; Kadugu, *T*; Rai (India). (*Brassica juncea.* Cruciferae.)—An annual, 2–3 ft. high, introduced and naturalised in India, Ceylon, etc., commonly found in waste ground at low elevations. The small round seeds are much used as a condiment and for flavouring pickles, etc. It is similar to the European Mustard (*Brassica nigra*), whose seeds when ground form the familiar mustard of commerce. Seed may be sown in drills or broadcast on a smooth surface of loose, friable soil.

Parsley. (*Petroselinum sativum.* Umbelliferae.)—From early times this has been cultivated as a medicinal plant. In more recent times, however, it has been used for seasoning and garnishing purposes, and no garden is complete without it. It grows luxuriantly in up-country gardens in the tropics and, with some shelter from the sun and heavy rains, will also thrive tolerably well at medium or low elevations. Seed may be sown at the end of the heavy rains, or on the plains before the cold weather sets in, either in drills or as an edging to borders; or in a box under cover, afterwards transplanting the seedlings with a good ball of earth. A rich humous soil suits the plant, and light shade is beneficial. Sutton's Imperial Curled, Myatt's Garnishing, Double Curled, etc., are good varieties.

Rosemary. (*Rosmarinus officinalis.* Labiatae.)—A dwarf shrub, native of S. Europe, commonly grown in cool countries for its fragrant leaves, which are occasionally used for seasoning, also in the manufacture of Eau-de-Cologne and other scents. Propagated from seed and is suited to hill gardens. (See *Perfumes.*)

Rue; Herb of Grace; Arudha, *S*; Tirumuti-patchi, *T.* (*Ruta graveolens.* Rutaceae.)—A small under-shrub with small, glaucous-grey leaves, commonly grown in gardens in Europe. The leaves have a strong overpowering odour and a hot, bitter taste; they are sometimes used in medicine as a stimulant and carminative. The plant may be grown in shaded spots at low or medium elevations, but does best up-country. It is often grown in peasants' gardens in Ceylon, being valued in native medicine. Propagated from seed or cuttings.

Sage. (*Salvia officinalis.* Labiatae.)—This well-known seasoning plant is successfully cultivated in hill gardens in the tropics, and will also thrive at intermediate elevations if seed is sown at the beginning of the wet or cool seasons. It is a small evergreen shrub, native of S. Europe, and grows best in light, rich, well-manured soil. Propagated by seed or cuttings.

Summer Savory. (*Satureia hortensis.* Labiatae.)—A small annual herb with small oblong leaves, native of S. Europe, commonly cultivated as a seasoning herb. The whole plant is aromatic, and the tops are used for flavouring salads and soups, or boiled with peas, beans, etc. Suited to hill gardens only. **Winter Savory.** (*S. montana.*)—A small evergreen shrub, native of S. Europe and N. Africa, often grown for seasoning purposes. Prop. by seed or root division.

Tarragon. (*Artemisia Dracunculus.* Compositae.)—A perennial herb, cultivated in Europe for its aromatic leaves, which are undivided and lance-shaped; these and the young tops are sometimes used in salads and soups, or pickled with cucumbers, and an infusion of them forms the well-known tarragon-wine. Requires a light friable soil, and is generally propagated by division of the root-stock.

Thyme. (*Thymus vulgaris.* Labiatae.)—This dwarf shrubby plant is a favourite amongst seasoning herbs, the aromatic leaves being generally relished for flavouring soups, stuffing, etc. Thrives in hill gardens, preferring a light rich and rather dry soil and a sheltered situation. Propagated by root division or by seed sown under cover. Makes a useful edging for beds or along paths in the vegetable garden; also suitable for rockeries.

SECTION IV

CHAPTER XXV

BEVERAGES AND EDIBLE PRODUCTS

(See also pages 278–320.)

Tea. Chai or Cha-e ; Thay-gas or Thay-kola, *S* ; Tey-ile, *T*.—The tea of commerce consists of the cured young leaves and tender tips of shrubs belonging, it is supposed, to either of two distinct types or races of *Camellia Thea*, namely var. *Viridis* and var. *Bohea*, both of which comprise numerous sub-varieties or jats. The former, a native of N.E. India, is considered to be the origin of most of the varieties (including Assam Indigenous and Manipuri) now cultivated in India, Ceylon, Java, etc. The China Tea (var. *Bohea*) is distinguished by its squat, straggling habit and comparatively thick leaves ; it is the kind chiefly grown in China and is cultivated on some of the higher estates in Ceylon, being hardier than, but not so productive as, the Indian varieties referred to. The " Assam Hybrid " is considered to be a natural hybrid between the " Assam " and " China " varieties. Left to itself the " Assam Tea " is an erect tree, 30–40 ft. high, but in cultivation it is topped early at a height of about 2 ft. and kept as a bush, not being allowed to grow higher than about 4 or 5 ft., except of course for seed purposes. The Tea plant normally lives to a great age. The oldest Tea in continuous cultivation in Ceylon is over 70 years old, and shows no falling off in quality or yield.

Tea has been cultivated from time immemorial in China and Japan. Its cultivation in Ceylon on a commercial scale may be said to date from 1867, although the earliest record of its introducion to the Botanic Gardens goes as far back as 1839 for " Assam Tea," and to 1824 for " China Tea." Tea-leaf was first introduced into England about 1658, when it cost £3 per lb. The plant is now extensively grown in S. India, Bengal, Assam, Java, Ceylon, etc. In the latter country the export rose from 23 lb. in 1873 to nearly 244 million lb. in 1931, and about 418,000 acres are now under the product. China is considered to be the largest tea-producing country, but the bulk of its production is consumed locally. In recent years, Tea has been successfully established on a commercial scale in Natal and E. African colonies.

Cultivation. The plant is adapted to a wide range of climate and soils, provided the rainfall is abundant (not less than about 85 in.) and evenly distributed. In Ceylon it thrives from sea-level to over 6,000 ft. It will not flourish in a dry climate, especially at low elevations, and is not particular as to soil, provided this is deep and well-drained, for it has a long tap-root. It is tolerant of, or partial to, an acid soil, which should be of a humous nature. Humus may be supplied by means of green-manuring, or by thinly interplanting with quick-growing leguminous trees which

can be lopped frequently, the twigs and leaves being lightly forked into the ground. (See *Green Manures.*) Manuring periodically, either with artificial or cattle manure, is necessary in order to maintain the bushes in a healthy and vigorous condition. The cost of manuring is usually considered to average about 1*d.* to 1½*d.* per lb. of made tea, or an average of about £3 per acre per annum.

Propagation, planting, etc. Tea seed is usually sold by the maund (80 lb.), which contains from 18,000 to 20,000 seeds, according to jat (variety), the better the jat the heavier the seed. Manured and well-cultivated seed-bearing trees generally yield the heaviest and best seeds. A maund should produce from 14,000 to 18,000 plants, or sufficient to plant 3 acres at 4 × 3 ft. spacing, or 4 acres at 4 × 4 ft., making a liberal allowance for failures.

Seed is sown in nursery beds at distances of 4 in. each way, the beds being shaded by fern fronds or Grevillea leaves fixed in the ground slanting-wise. It is best, however, to raise plants in small plant-baskets or bamboo-joints, as these may be planted out direct without injuring the roots. Efforts have been made to propagate Tea by root-cuttings and other vegetative means, but, though theoretically much to be desired, these methods have so far not been found a commercial success. In about 10 months from sowing, the seedlings should be about 12 in. high and ready for planting out in the field. Holes being made in lines, the plants are set out at distances of about 4 × 3 ft., 4 × 4 ft., or 5 × 4 ft., then shaded, and watered when necessary, until well established. About 18 months after planting, the plants are topped, *i.e.* cut back to about 15 in. from the ground, so as to induce a bush form.

TEA-FIELD IN CEYLON, WITH PLUCKERS AT WORK.

Plucking, yield, etc. The first crop of leaf is obtained in the third year in the low-country, being a year or so later at higher elevations. At low elevations plucking takes place about once in 8 or 10 days, and at the higher altitudes once in 2 or 3 weeks, according to elevation. Plucking is usually done by women or boys, and consists in nipping off by hand the tender end leaves with bud and shoot ; taking two leaves with shoot and end bud constitutes *fine* plucking and forms good quality tea, while four leaves and a bud forms *coarse* plucking and yields tea of a lower quality. Pluckers will gather from 30 to 80 lb. or more green leaf a day, according to the condition of the field and the activity of the pluckers. 4 lb. of green leaf will produce 1 lb. of made tea. When the bushes stop " flushing," they are pruned back severely, this being necessary at intervals of about 16–20 months in the low-country and about 3 years up-country. When in full bearing, at 7 or 8 years old, the crop of made tea may, according to elevation, nature of soil, and degree of cultivation, be from about 400 lb. to 1,000 * lb. or more per acre ; 700 lb. is considered a good average yield. Altitude is an important factor, for on this the quality of the tea largely depends. High-grown tea, say from 5,000 to 6,000 ft., commands the highest price and is generally used for blending with lower grades from low elevations.

Curing (**Black Tea**).—The leaf being brought to the factory, it is *withered* on tiers of hessian screens in drying sheds, through which hot air from furnaces is driven ; it is then *rolled* by means of rolling-machines, during which the process of *fermenta-*

* On Mariawatte Estate, Gampola, Ceylon, a field of over 100 acres gave an average of 1,357 lb. per acre for over 20 years.

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tion or oxidation sets in. Fermentation is continued by spreading the mass of bruised leaf for 1 or 2 hours in a damp, cool atmosphere. *Firing* is done in drying-machines, then *sifting*, by means of which the tea is simultaneously sorted into *grades*, as Souchong, Pekoe-souchong, Orange-pekoe, Broken orange-pekoe (the best quality), and Dust or Fannings. It is then packed into lead-lined chests of uniform sizes for export. A full-size chest contains 80–100 lb.; a ½ chest, 40–50 lb.

Green Tea, as distinct from *black* or ordinary tea, is made by subjecting the green leaf at once to a process of steaming in a revolving cylinder, and afterwards by rolling, drying, etc., the processes of withering and fermentation being omitted. The grades are known as Hyson, Young Hyson, and Gun-powder. China teas are usually made on this principle. There is a certain demand for China or Green Teas in some countries, notably the United States, and Ceylon manufactures and exports a considerable quantity to meet this demand.

Brick Tea. A cheap and coarse tea, made in China and used largely in Tibet, Mongolia and Siberia, where it is held in high repute and often used as barter. It is made in two forms, one of which consists almost entirely of twigs and leaves of the tea plant, pressed with a glutinous substance and dried in moulds; the other is made up of the finer siftings and dust of ordinary tea compressed into slabs. The latter is consumed chiefly in Russia, and is prepared in various ways for use, being either brewed like ordinary tea, or boiled, stewed and flavoured with salt, butter, etc.

(1) Assam Tea (*Camellia Thea* var. *assamica*); (2) Maté Tea (*Ilex paraguensis*).

Leppet or **Leptet Tea** is prepared in Burma and the Shan States, where it is used as a vegetable rather than a beverage. It consists of green tea-leaves pressed and preserved on the principle of a silo, these being afterwards prepared for use by mixing with garlic, salt, oil and other ingredients.

Soluble Tea. A process was invented by the late Mr. Kelway Bamber, Ceylon Government Chemist, by which the essence of tea was extracted and rendered available in a concentrated, soluble, fine powder form, known as "Soluble Tea." Though it had much to recommend it, especially for travellers, it was not a commercial success.

Tea cider is a name given to an effervescent, sub-acid and refreshing beverage made from tea in India, Ceylon, Java, etc., and containing about 2% of alcohol. It is sometimes made when Tea does not command an economic price.

Maté, Yerba de Maté or **Paraguay Tea**; "Hervia." (*Ilex paraguensis.* Ilicineae.)—A small shrubby tree, with alternate, serrate leaves, not unlike those of the Tea plant, native of S. America, where it is extensively cultivated, the dried leaves being used like tea. In Brazil and Paraguay, maté forms one of the leading articles of local trade, being also exported to neighbouring countries in considerable quantities, and occasionally to Europe for medicinal purposes. From Brazil alone, the annual export, chiefly to Argentina, is about 140 million lb., valued at over 2 million pounds sterling, averaging about 4*d*.–5*d*. per lb.

In preparing the leaves for use, they are first partly dried in the sun, then artificially heated, the latter process requiring practically all the skill necessary in the preparation of the product. The leaves must be dried thoroughly and evenly, without scorching; they are then usually ground small and packed tightly into bags for market. An infusion from them may be prepared and served in the same way as tea, but it is customary to drink it from the spout of a tea-pot, or through a tube (bombilla) with a strainer at the bottom. The tea contains about 2% caffeine, and is the favourite beverage of a large proportion of the population of Brazil, Paraguay, Uruguay, Argentina, etc., being considered to be a mild stimulant, laxative and diaphoretic, and to have the power of "increasing intellectual lucidity and vigour." The plant has been introduced at Peradeniya, Ceylon, and thrives in ordinary soil. It is suited to similar climatic conditions and soil as Tea.

Khat or Cafta; Arabian Tea (*Catha edulis*).

Arabian or **Abyssinian Tea**; Khat or Cafta. (*Catha edulis.* Celastraceae.)—A small shrub, 6–8 ft. high, native of and cultivated in Arabia, Abyssinia, etc., introduced in 1882 at Peradeniya, where it flourishes in ordinary soil, with or without shade. The leaves and young twigs form a considerable article of local trade in its native habitat, being made into a beverage like tea, or chewed both in the green and dry state. The plant has stimulating or hypnotic properties, and its use in its native home is of great antiquity, preceding that of coffee. In appearance the plant is not unlike ordinary Tea. At one time its use was prohibited among the Arabs by the Koran, but a later decree freed it on the ground that it "only produced hilarity and good humour."

Ayapana Tea. (*Eupatorium Ayapana.* Compositae.)—A low, spreading, semi-herbaceous, creeping shrub, 2–3 ft. high, with long, narrow leaves, which as well as the stems are of a bronze tint. It is indigenous to Brazil, and cultivated to some extent in Mauritius and Réunion for the sake of its medicinal properties, the leaves and young twigs being used for making a decoction like tea, which is regarded as a mild stimulant and a cure for dyspepsia. The plant is also sometimes cultivated in India, where it is similarly employed and esteemed by some. It is easily propagated by cuttings or suckers, and thrives on ordinary soil, in partial shade, at low or medium elevations. It seldom produces seed, and has the habit of rooting at the nodes of the trailing stems.

Jesuit's Tea, or Culen. (*Psoralea glandulosa.* Leguminosae.)—An erect herbaceous shrub, native of Chile, the leaves of which are used to make a decoction known as Jesuit's Tea, which is valued more for its medicinal properties than as a beverage, being a vermifuge and a stomachic.

Matara Tea. (See *Cassia auriculata.*)

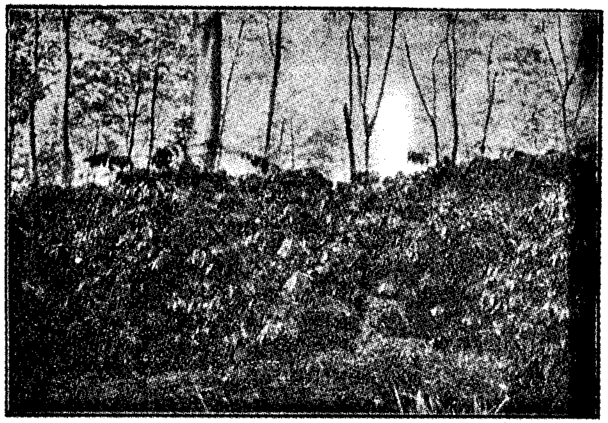
Faham or **Foam Tea.** (*Angraecum*

Ayapana Tea (*Eupatorium Ayapana*).

fragrans. Orchideae.)—The dried fragrant leaves are prepared in the Island of Bourbon and sold for use as tea in France. They are also made into cigars in Mauritius, being wrapped with tobacco leaf.

Coffee. Caffé, Kap-pé, Kopai, etc.—The use of coffee as a beverage was first known in Abyssinia about the beginning of the fifteenth century. It was introduced into England in 1652, and the plant was first brought to Ceylon about 1690. Its cultivation on commercial lines was begun in that island in 1825, and in due course it became the country's leading product. These remarks refer to the Arabian Coffee (*Coffea arabica*), which species, or varieties of it, furnishes the bulk of the coffee of commerce. It is a small slender tree, native of Abyssinia, and has been introduced into most tropical countries. It is cultivated extensively in Brazil and other S. American States, also in S. India, Java, W. Indies, E. Africa, etc.

Coffee has a varied history. About three-quarters of the world's supply now comes from Brazil. Its cultivation in Ceylon, which exported over a million cwt. in 1874, was practically wiped out by the Coffee-leaf disease (*Hemeleia vastatrix*). While, however, the cultivation is dwindling in some countries, in others it has been considerably extended in recent years, notably in Kenya and other parts of East and Central Africa. The market value of coffee fluctuates from 35*s.* to 85*s.* or more per cwt., depending on market conditions and quality, the latter being determined by flavour, colour of beans, regular grading, etc. Costa Rica and Jamaica ("Blue Mountain") coffees command the highest prices, Kenya and S. India coming next. These and similar forms are classed on the market as "Mild Coffee," as distinct from the Brazilian product, which is generally considered a strong type and is in a class by itself.



ARABIAN COFFEE (*Coffea arabica*).
Under shade of Dadap trees in Java.

Cultivation. Coffee thrives in a moderately humid atmosphere and prefers deep friable soil on undulating land; it is unsuited to stiff clay or sandy soils, and is considered tolerant of acid soils. The "Arabica" thrives from 1,500 to 5,000 ft. or higher, while the "Robusta" type is suited to lower elevations, and the "Liberica" to elevations below 2,000 ft. Propagation is by seed sown in nursery beds or, preferably, in basket- or bamboo-pots. The seed germinates in 5–6 weeks, and the seedlings should be ready for planting out about 10 months later. Spacing should be not less than 7 × 7 ft. for the "Arabica," and about 10 × 10 ft. for the more robust "Liberica" and "Robusta." *Shade* must be afforded until at least the plants are established; light permanent shade is usually beneficial, if not essential, except

perhaps at the higher altitudes and in the case of "Liberica." In Kenya and Uganda shade is not considered necessary, but in India, Java, Arabia, Mexico and other S. American States it is important. Different trees (see p. 208) are employed for shade, *e.g.* Dadap, Mortelle, Grevillea, Albizzia, Acrocarpus, Leucaena, etc. The last-named is favoured in Java, Sumatra and Ceylon, especially in the early stages of the crop. The coffee plants being surface feeders, manuring is indispensable, including green manures and, when available, farmyard manure.

Pruning consists mainly in thinning out weakly or superfluous branches and maintaining the bushes in proper shape, and is carried out after harvesting the crop. The plants should be topped to 18 in. when about 4 ft. high, so as to form spreading bushes, which may be kept at a convenient height of about 5–6 ft. In India and Ceylon the bushes blossom chiefly in March or April, after the commencement of the rains, the crop being harvested in October–December, *i.e.* 7 or 8 months later.

Yield. The first crop, a small one, is produced when the plants are 3 years old. When in full bearing, at the age of 6–8 years, a yield of about 1–1½ lb. of cured coffee per tree, or about 5 cwt. per acre, is considered a good average crop, though in some cases 7–8 cwt. or 2–3 lb. per tree may be obtained. The bushes continue to yield for about 30 years or longer. The berries are picked when they turn red, and a good worker can pick 3 bushels or more a day. A bushel of fresh berries will yield about 10 lb. of marketable coffee, or 5 bushels about 1 cwt. Each berry or "cherry" contains 2 seeds ("beans") facing each other by their flat sides; sometimes only one sound seed, called "pea berry." About 800 fresh seeds go to a lb., and 1½–2 lb. should be sufficient to plant an acre, allowing for failures.

ROBUSTA COFFEE (*Coffea robusta*).

Curing. *Pulping* (*i.e.* removing the shell or pulp of the berries) is done by a pulping machine soon after the berries are picked. The beans are then *fermented* for 12–18 hrs. in concrete tanks or wooden boxes in order to remove the saccharine matter and facilitate drying. They are then washed in running water, and dried on a barbecue or on trays placed in the sun. *Drying* takes about 3 weeks and should be gradual. The beans are then known as *Parchment* coffee. The parchment or "silver skin" is afterwards removed by *hulling*, which is either done locally or after export, during which process *grading* and *winnowing* are also performed. Sometimes the berries are simply dried whole, being then known as *native* coffee or *dried berry*. In this form the superior qualities of the coffee are said to be retained, but the subsequent processes of pulping, etc., are more troublesome and transport is more costly. Coffee owes its stimulating quality to the presence of *caffeine*, which is similar to *theine* of tea.

Pests and Diseases (*q.v.*). The most serious of these is probably the Coffee-leaf disease (*Hemeleia vastatrix*). It is considered that moderate shade by means of suitable trees (*q.v.*) has the effect of maintaining the normal health and vigour of the plants, thus increasing their resistance. Spraying with "Bordeaux Mixture" (*q.v.*) or other fungicides are the best means of controlling the disease.

Liberian Coffee. (*Coffea liberica.*)—A robust-growing tree, native of W. Trop. Africa, introduced to Ceylon about 1870, distinguished by its considerable height (30 ft. or more if left to itself), large, thick leaves and large berries. The tree does not require shade, bears fruit almost throughout the year, but the product commands a lower price than the "Arabica." The berries do not drop as soon as ripe, as do those of the latter, and have a tougher and more fibrous shell. The vigorous constitution of the tree renders it more or less resistant to the leaf-disease, and a

yield of about 6–8 cwt. per acre may be obtained. Suited to low elevations only, *i.e.* up to about 2,000 ft. Planting distances may be about 10 × 10 ft. or 12 × 12 ft. The plants should be topped to 2½ ft. when at a height of about 5 ft.

Excelsa Coffee. (*Coffea excelsa*).—A vigorous species, indigenous to Cent. Africa, with large, handsome leaves. This and **Abeokuta Coffee,** also of Trop. Africa, are both of the Liberica type and, like the latter, appear to possess considerable powers of disease resistance. The former gave a crop of over 10 lb. per tree at the Peradeniya Experiment Station, Ceylon, and a similar yield in Trinidad.

Congo- or Robusta-Coffee. (*Coffea robusta = C. Laurentii.*)—A species indigenous to Cent. Africa, recently brought into cultivation, distinguished by its large, handsome, wavy leaves, introduced to Ceylon in 1900. It has given very satisfactory returns in Malaya as a catch-crop with young rubber; thrives at low and medium elevations, yielding a crop of about 1 cwt. per acre 2½ years after planting, 4–5 cwt. in the 3rd or 4th year, and 6–8 cwt. in the 5th year. 600 seeds go to a pound. Other species (or varieties) of this type are: Uganda Coffee, Canephora, and Quillou, all suited to fairly low or medium elevations.

HYBRID COFFEE AT PERADENIYA, CEYLON.

Upland Coffee of Sierra Leone. (*Coffea stenophylla.*)—A slender-stemmed, small-leaved W. African tree, reaching a height of about 25–30 ft. if left to itself; bears a profusion of small ovoid berries, which are black when ripe and reported to have a superior flavour. Introduced at Peradeniya in 1894; flourishes and bears an abundant crop, usually in December–January.

Hybrico Coffee. A Brazilian hybrid whose berry contains 4–6, instead of 2, seeds; its quality is well spoken of, but it does not appear to be known in the East.

Maragogipe Coffee, of Brazil, is of a robust habit with large leaves, similar to the Liberica. This has been established at Peradeniya since 1884, but although the tree flourishes here it bears but scanty crops.

Hybrid Coffee. There are several hybrids of Coffee, among the best being a cross between the Arabica and Liberica, which bears heavy crops of good-sized berries. This has yielded an average of 14 lb. dried berries per tree, for 150 trees, at the Peradeniya Experiment Station, Ceylon. The plant is a vigorous grower, and its robust constitution appears to render it to some extent immune from leaf-disease. (See fig. above.) Kent's Hybrid is well spoken of in S. India.

Mocha Coffee. The coffee of Arabia and Abyssinia, being exported from the town of Mocha, is generally known in the trade by this name, the best of which is produced in the province of Yemen. It is a variety of "Arabica," with rather small berries, and is of a superior flavour and aroma.

Cacao or **Chocolate Tree**; Chocolath-gas, *S*; Coco-maram, *T*. (*Theobroma Cacao.* Sterculiaceae.)—A small tree, 15–20 ft. high, with large oblong, pointed leaves, native of tropical America, cultivated extensively in its native home as well as in the W. Indies, Gold Coast, Java and Ceylon. Cacao was first introduced into Ceylon about 1819, but its systematic cultivation was not undertaken till about 1878, when the first export of 10 cwt. was recorded. The area now under the product here is about 20,000 acres. About two-thirds of the world's Cacao supply is furnished by the Gold Coast, from which the annual export has grown from 80 tons (in 1891) to 250,000 tons, with an estimated area under the crop of over a million acres, averaging a yield of about 430 lb. per acre. Owing, however, to inadequate labour and difficulty of transport, the quality of the product is of a comparatively low standard.

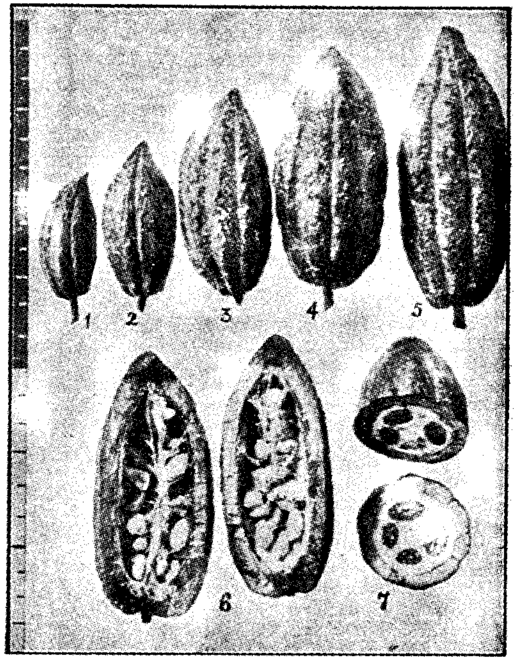
CACAO TREE (*Theobroma Cacao*), "NICARAGUA" var.

The tree bears a profusion of small pinkish or yellowish flowers, in bunches on the stem and older branches, followed 5–6 months later by the ripe fruit. The latter is a large, warty or furrowed pod, 6–9 in. long, red, yellow or grey when ripe. Each contains from 25 to 36 large seeds, closely packed in a central column and covered with a white mucilaginous substance.

Cultivation, etc. The tree thrives at elevations between 1,000 and 2,500 ft., with an evenly distributed rainfall of 75–80 in. a year. It has a long tap-root, and requires deep and well-drained soil, light shade, and shelter from strong winds. The thornless "Dadap" (*Erythrina lithosperma*) and allied species, interplanted about 50–60 ft. apart, form very suitable shade and afford a certain amount of protection from wind. In some countries, however, as in Grenada, permanent shade is not considered necessary, but the crop is often interplanted with Nutmegs.

Propagation is by seed (rarely by budding), which must be sown fresh, preferably in plant-baskets, the seedlings being planted out (with baskets) in the field when about 15 in. high. The seeds germinate in about 3 weeks, and the seedlings, which grow at a rapid pace, are ready for planting out in about 4–5 months after sowing. Planting distances should be about 15 × 15 ft., say 200 trees to the acre. *Catch-crops*, such as Bananas, Cassava, etc., are sometimes grown between the rows for the first two or three years, both for the purpose of yielding an interim return and affording temporary shade. The suppression of coarse weeds is important, as is also the cultivation of ground-covers or green-manures. A light forking of the ground should be carried out once a year, and a round of light pruning two or three times a year. Excessive pruning is injurious and exposes the fruit to insect attacks, especially the "mosquito blight" (*Helopeltis*). When young, the plants should be allowed to develop 3 or 4 primary branches from a single stem, and from these, secondaries and tertiaries in consecutive order, keeping in view the admission of light to the centre of the tree and the symmetrical form of the latter.

Harvesting, Curing, Grading, etc. In harvesting, the pods must be cut off, not pulled or torn; they are collected into heaps, then cut or broken open (*shelling*). The seeds ("beans" or "nibs") are then carried to the curing house, placed in a strong wooden box or cement-lined tank to undergo "sweating" or fermentation for about 36–48 hrs., the period varying somewhat in different countries, the beans being turned over and washed once a day. They are then spread out on matting or barbecue in the daytime to dry, being covered with sacks at night, or placed in bags and brought under cover, to be spread out again the following day. About 6–8 days are thus required to complete fermentation and drying, the time varying according to climate. Owing to uncertainty of the weather, a drying- or curing-house, heated with hot air and containing tiers or floors covered with matting, is now generally provided; or a sliding roof over a barbecue may be adopted. Colouring the beans with annatto, red clay, or brick-dust, etc., or polishing them by rubbing with the hands, or by "dancing" among them with bare feet, is sometimes practised in order to give them a good appearance in the trade. When curing is complete, the beans are sorted into grades. Large, plump, well-coloured and smooth beans form *first quality*; flat, wrinkled and small being *second*; and broken, black, or squirrel-damaged, *third*. They are then packed in bags for export, 112 lb. usually going to a bag. Ceylon and Trinidad cacao, owing mainly to careful curing and grading, have a good reputation in the trade. The former country exported in 1933 nearly 64,000 cwt. valued at about 22*s*. per cwt., against 70*s*.–80*s*. before the slump.



DEVELOPMENT AND STRUCTURE OF CACAO FRUIT. (1–5) Growth of pods from 1 to 5 months; (6 and 7) long and cross section.

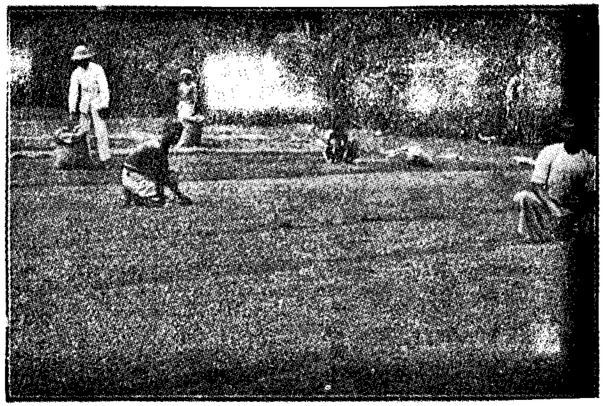
SHELLING CACAO PODS.

Yield. A small crop may be obtained in the fifth year from planting, but the trees

are not in full bearing until at least 10 years old. The principal crop in Ceylon is produced from October to January, and a smaller one from May to July. In a plantation, however, no period of the year is entirely without some crop. About 3 cwt. cured beans per acre is a fair average yield, although as much as 5 cwt. or more is sometimes obtained from specially good and well-cultivated trees. 70–80 pods per tree may be usually obtained, but some trees under favourable conditions may bear as many as 300 or more. 50 average pods should yield 2¼ lb. of made cocoa.

In the preparation of cocoa powder, the cured beans are subjected to processes of roasting, nibbing, grinding, heating, etc. Certain ingredients are added, and the butter-like fat of the beans, known as Cocoa-butter or Oil-of-theobroma, is extracted. This is a valuable by-product, used in medicine, etc. To make chocolate, further ingredients, as sugar, milk and aromatic substances are added, and the whole ground into a paste. Inferior chocolates are often made of or adulterated with nuts and various vegetable fats.

Varieties. There are numerous more or less distinct types or varieties, which may be classed into 2 or at most 3 groups, viz., "Forastero" (= foreign), "Criollo" (= native), and "Calabacillo" (= small calabash). The last named, formerly regarded as a form of Forastero, is now considered a distinct type. The typical Forastero has a thick and deeply furrowed bottle-necked pod, and is either red or reddish-yellow; the seeds are large and numerous, somewhat rounded, and purplish in section; the tree is a vigorous grower and usually a prolific bearer. Owing to cross-pollination, however, this type has become very variable. Some of the best varieties of Forastero are "Cundeamar," "Amelonado," "Ocumare," "Verdilico" and "Cayenne." The Criollo type (known in Ceylon as "Caracas" or "Red Ceylon"), is distinguishable by its smaller, thin-shelled and red pods, with rather globular seeds which are usually white in section; these were formerly much valued and commanded a high price. The tree is of a rather delicate nature, and though once the principal variety grown in Ceylon, it is now almost extinct here. The "Calabacillo" has usually a small and roundish pod with a smooth skin, the beans being flat, and dark-purple in section. "Amelonado" is the variety chiefly grown in W. Africa, it being considered there to give the best yield under varying conditions.


DRYING CACAO BEANS ON MATTING IN THE SUN.

Theobroma pentagona, or "Alligator Cacao," is a distinct species, introduced to Peradeniya from Trinidad in 1895. The pods are small, with five prominent ridges; seeds large but few, white in section. The bean is said to be of good quality, but the tree is a scanty bearer in Ceylon.

T. angustifolia. Monkey Cacao. A remarkable species of no commercial value, introduced at Peradeniya in 1895. It fruited there for the first time in 1909, bearing large, hairy, brown and furrowed pods.

Pests and diseases (*q.v.*). The Witchbroom Disease, or Kruloten, a destructive parasitic fungus (*Colletotrichum luxificum*) is prevalent in some S. American States, notably Ecuador and Surinam. It causes the production of swollen twigs in bunches, resembling brooms, and the pods become hard and useless. Its spread is said to be partly due to errors of cultivation, as when the trees are allowed to grow to an impracticable size, making it impossible to afford the necessary attention with

regard to pruning and the removal of pestilential growths. **Remedy:** Remove and burn infected parts and spray with fungicides (*q.v.*).

Guarana. (*Paullinia Cupana.* Sapindaceae.)—An ornamental climber with small pinnate leaves, native of Brazil, introduced at Peradeniya in 1882. The small brown seeds are dried, powdered, and made into dough with water; this is then formed into sausage-like brown rolls, 5–8 in. long, or in shapes resembling birds and animals, which become very hard when dry. It is used throughout Brazil and other parts of Trop. America for making a refreshing beverage, also in medicine. Every traveller carries a piece of guarana, and, when desired, a small portion is grated off and dissolved in water to form a stimulating beverage like tea. Guarana contains 4–5% of *guaranine*, an alkaloid similar to *theine* of tea and *caffeine* of coffee. It is exported and used in medicine as a nerve stimulant.

Kava; Yagona. (*Piper methysticum.* Piperaceae.)—A shrub, 6–8 ft. high, with fairly large, round or cordate leaves, indigenous to Fiji and other Pacific islands. An extract from the roots, after undergoing fermentation, is used as a refreshing drink, known as "kava" or "yagona," which forms a national beverage in the countries referred to, being used as a token of good-will and on ceremonial occasions. Its refreshing effects are highly spoken of by those who have partaken of the beverage, the serving of which is attended with peculiar ceremony.

The plant is commonly cultivated in Fiji, etc. In planting, spacing is about 6 × 6 ft., or about 1,200 plants to the acre. A crop of roots is obtained in 3–4 years after planting, each plant averaging about 3 lb. of dried roots, which are worth locally about 1*s.* per lb. Fresh roots may, however, be dug up from the plant from time to time as required. When the crop is renewed, the plants are uprooted and the ground is prepared for replanting. Excessive kava-drinking is liable to produce skin disease and weaken the eye-sight. The usual method of preparing the beverage is by chewing the roots and ejecting the saliva into a bowl, where it is allowed to ferment. The chewing is usually done by boys or girls with good teeth, but this method, I am informed by Mr. Jepson, is now forbidden by law in Fiji, owing to its liability to spread disease.

Sugar-Cane. Uk-gas, *S*; Karambu, *T*. (*Saccharum officinarum.* Gramineae.)—A tall perennial grass or reed, with canes reaching a height of 8–12 ft. or more and a diameter of 2½ in., the coarse leaves being 2–4 ft. long; considered to be a native of E. Trop. Asia, but found in a cultivated state in all tropical countries. In some it is grown commercially in extensive areas for the production of cane-sugar; in others as a garden plant for the sake of the sweet juicy canes, which are used for chewing, etc. The cultivation of the plant dates back a long period. The chief countries of cane-sugar production now are India, Java, and Cuba, each producing a million tons or more annually. It is also grown on an extensive scale in Mauritius, the Guianas, Hawaii, Fiji, Philippines, Brazil, E. Africa, etc.

Cultivation. The plant requires a hot, humid climate, alternating with dry periods, and thrives best at low elevations on flat land, with stiff loamy or alluvial soil; it flourishes, however, in any ordinarily good soil, provided the necessary moisture is available. The crop is an exhausting one, and manuring is indispensable, while lime is an essential ingredient in the soil. It is generally grown for several years in the same ground without change.

Propagation is by cuttings (setts), which are usually selected from the upper joints of the canes, cut in lengths of 8–10 in. (including 3–4 joints) and placed in trenches or furrows 10–12 in. deep and V-shaped in section. The cuttings may be

inserted slanting-wise, 2 or 3 in each stool, about a foot apart and nearly covered with soil. Spacing varies according to variety and local conditions; usually it is about 5 × 4 ft. The cuttings (called "plants") sprout in 10–14 days; the first or "mother" sprout is removed so as to induce the plant to tiller. Subsequently weeding, forking the soil and earthing up the plants must be attended to when necessary. All dead leaves ("trash") should be left on the canes in dry weather, but in wet weather they should be removed and buried between the rows.

Harvesting commences, according to variety of cane and climate, about 14–20 months after planting, the canes becoming tough and turning pale yellow when ready for cutting. They are cut as close to the ground as possible, for the root end is the part richest in sugar. The rootstocks (stools) will continue to crop for several years, often as many as 8 years or more, each crop after the first ("plant crop") being known as *ratoons*, as "first," "second," "third" ratoon, etc. In some countries, *e.g.* Java, no ratoon crops are grown, owing to their liability to disease, the "plant crop" only being depended on.

Yield, etc. Under favourable conditions a yield of 30 tons or more canes per acre should be obtained; often, however, it may not be more than 25 tons, varying according to variety of cane, etc. Good varieties should give about one ton of sugar for every 9½ tons of cane; thus the crop may vary from 2 to 4 tons or more marketable sugar per acre. The canes are crushed or macerated by machinery, the sweet saccharine juice being afterwards submitted to processes of clarifying (in which lime is used to neutralise the acids), heating, filtering, bleaching, etc. The fibrous material left after the juice is extracted (megass) is used as fuel for the engines. A new use has recently been discovered for it in a commercial material called "Celotex," which is made into boards for interior decoration and for sound- and weather-proof purposes. Raw sugar, or muscovado, is boiled and clarified to form crystallised or white sugar, and this is at once ready for consumption. Molasses and treacle, from which rum is made, are the uncrystallisable product from the muscovado or raw sugar.

SUGAR-CANE (*Saccharum officinarum*).

Varieties. Numerous varieties are known in cultivation, each country having its own favourites. "Otaheite" or "Bourbon" is an old favourite in the W. Indies; "Rose Bamboo" in Hawaii; "Crystalina" in Cuba; Cheribon (purple) in Java; and "Uba" or "Yuba" in Natal and other parts of East Africa. The last named stands drought well and gives 10 or 12 ratoons. Several rich seedling varieties have been raised in Java, W. Indies, etc., by hybridising and crossing.

Sugar cultivation has been tried in Ceylon at different times, but although the growth of the cane was satisfactory the industry did not prosper. The cane is, however, commonly grown in village gardens, being used for chewing and is often a stand-by with pilgrims.

Palm-sugar or Jaggery is obtained from the juice or sap of several species of palms. The methods of extracting the juice vary somewhat with different species and in different countries, but the mode of converting it into sugar is practically the same in all cases. In the case of the Kitul, Palmyra, and Coconut palms, which are those generally used in Ceylon, the young inflorescence (spadix) is tapped before it is fully developed. This is first gently beaten with a mallet, and a couple of days

later a slice is taken off the end. The operation is repeated each evening (not necessarily the beating), sometimes oftener, a thin shaving being removed from the end of the spadix each time, and the fresh toddy is collected overnight in an earthenware pot or gourd suspended close to the cut, and brought in in the morning. A little lime is smeared on the inside of the vessel to prevent the juice from rapidly becoming sour or fermented. The tapping is thus continued for several months, or until only a stump of the spadix is left. Another spadix may develop before the first is exhausted, and this is similarly taken in hand. The fresh toddy is sweet and pleasant to drink, but when fermentation sets in it becomes sour, intoxicating and cloudy, and in about 24 hours is unfit to drink. Similar remarks apply to the toddy of other palms.

If required for making sugar, the fresh juice or "sweet toddy" is boiled down, as a result of which a brown thick syrup ("gur" in India) is obtained. This is placed in baskets of palm leaves to harden, after which it resembles brown toffee, forming palm-sugar or jaggery, which is much used locally for sugar, sweetmeats, etc. One gallon of toddy will usually yield $1\frac{1}{2}$ lb. of jaggery, and each palm may give from 2 to 4 quarts of toddy a day. By fermenting the toddy for 4 or 5 days and then distilling it, a strong intoxicating spirit (arrack) is obtained, 100 gallons of the former producing about 25 gall. of arrack. This refers to the coconut palm, for arrack is not usually made from the palmyra and kitul toddy in Ceylon. Fermented for 2–3 weeks and spiced with chillies and other ingredients, palm toddy forms an excellent vinegar, commonly used locally for culinary purposes.

The following are the principal sugar-yielding palms:

Coconut Palm (*q.v.*).

Sugar Palm of India; "Wild Date." (*Phoenix sylvestris.*)—A tall species with stiff, pinnate leaves, allied to the Date palm, native of India, where it is cultivated for the production of sugar. It is estimated there are over 60,000 acres cultivated under the product in India, chiefly in the Madras Presidency. The method of extracting the juice is different from that described above, the tender portion of the stem near the top being tapped after the removal of some of the leaves. This is the principal source of arrack in India.

A V-shaped cut, about 3 in. wide and $\frac{1}{2}$ in. deep, is made across the bared portion of stem, and the juice as it exudes is conducted into a vessel suspended underneath on a bamboo. The collected juice when boiled down, as already stated, yields jaggery (sugar) or, when fermented and distilled, arrack. It is considered a profitable crop to the peasants, the palms being fit for tapping at the age of 8–10 years, yielding when mature as much as 9 tons of jaggery per acre, worth about Rs. 500 to Rs. 600. (Watt's *Commercial Products of India.*)

Date Palm (*q.v.*) is similarly used in Date-growing countries.

Sugar Palm of Philippines; Buri Palm. (*Corypha elata.*)—A tall, stout, erect palm with large fan-shaped leaves. At the age of 30–35 years the trunk yields, from an incision made just below the terminal bud, a juice rich in sugar. From 250 to 300 lb. of sugar can be obtained from a single tree in a season.

Sugar Palm of Java and Malaya; Gomuti Palm; Kabong (Malaya). (*Arenga saccharifera.*)—A large stately palm, with a stout trunk and very large, handsome, pinnate leaves, 25–30 ft. long, glaucous beneath, native of Malaya, where it is commonly cultivated. The sap or toddy is rich in sugar, and is extracted and collected in a manner similar to that practised with the Coconut palm (*q.v.*).

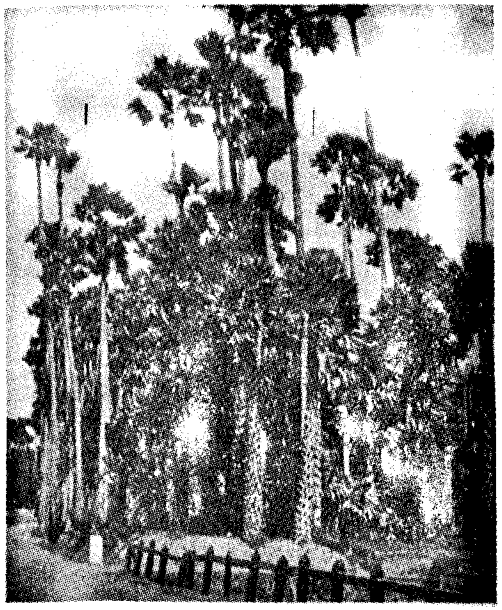
The palm flourishes in deep soil on sloping land, in the moist low-country and up to about 2,000 ft. It is fit for tapping at the age of about 12–15 years, a single palm yielding 25 lb. or more jaggery a year. Practically no cultivation is required once the palms are established. Like many other palms, the stem contains a large quantity of excellent sago or starch; hence it is sometimes known as the "Sago palm." In the Philippines a single stem when cut down is said to give about 200 lb. of sago. (See also *Bristle Fibres.*)

Toddy- or Kitul Palm. (*Caryota urens.*)—A very handsome palm, 50–60 ft. high, with large, spreading, bipinnate leaves, indigenous to Ceylon, India, Malaya, etc.

From the young inflorescence (spadix) is obtained, after the manner previously described, a copious flow of sweet sap ("toddy"), which upon boiling yields a quantity of brown sugar or jaggery. When fresh it is known as "sweet toddy," and on becoming sour as "fermented toddy," which is intoxicating. The palm is fit to tap when about 15–20 years old, when it commences to flower. Each spadix continues to yield for about 3 months, producing from 4 to 6 quarts of toddy a day, in some cases much more. A single palm, it is estimated, is capable of giving an annual yield of about 180 gallons. The Kitul yields excellent sago from the stem, also a commercial bristle-fibre from the base of the leaf-stalks. (See *Palms*, also *Fibres.*)

Nipa Palm; **Water Coconut**; Gin-pol, *S.* (*Nipa fruticans.*)—A small creeping aquatic palm, inhabiting salt-water swamps near the coast of Ceylon, Malaya, etc. In the Philippines and Malaya the sap from the immature inflorescence furnishes toddy, or is made into vinegar, sugar, or alcohol. It is considered the cheapest source of sugar known, one acre yielding as much as $1\frac{1}{2}$ tons of sugar without any cultivation. The leaves (attaps), 15–20 ft. long, are commonly used for thatching houses. Nipa swamps in the Philippines are said to cover as much as 20,000 acres. (See *Water Palms.*)

Sugar- or Wine-Palm of W. Trop. Africa. (*Raphia vinifera.*)—A large, handsome palm, with long, pinnate, arching leaves reaching a length of 30–40 ft., and producing an enormous bunch of fruit (spadix) from 10 to 12 ft. long.



PALMYRA PALM (*Borassus flabellifer*). At Jaffna, Ceylon.

Elaeis or **Oil Palm.** The tender portion of the stem, near the top, after being bared of leaves, is commonly tapped in Africa for toddy, from which sugar or arrack may be obtained. (See *Fixed Oils.*)

Palmyra Palm; Tal-gas, *S*; Panna-maram, *T*. (*Borassus flabellifer.*)—An erect dioecious palm, 60–80 ft. high, with a stout, erect trunk and a crown of short, rigid, fan-shaped leaves, indigenous to the dry region of Ceylon, India, Trop. Africa, etc. It is especially suited to a rather dry climate, and occurs naturally over large areas in the drier parts of S. India and Burma. In the dry northern parts of Ceylon it takes the place of the Coconut, which prefers moister climatic conditions. Like the latter, the Palmyra supplies food and drink and serves innumerable purposes, the female palm yielding 50 per cent. more toddy than the male.

The large black fruits (nuts), produced in a cluster at the base of the leaves, contain a refreshing sap, much relished as a cooling drink; the soft kernel of the

young fruit is much used as an article of food; while the germinated nuts, with the enlarged fleshy embryo (" kelengu ") furnish a useful vegetable, commonly sold in the bazaars. The copious sap (" tari ") obtained from the spadix is either used for drinking as toddy (unfermented), or boiled down within 5 hrs. of collection for making sugar (jaggery). Fermented for 4–5 days and then distilled, it produces arrack. The period of tapping extends to 4 or 5 months, mainly in the dry, hot season, and the annual yield per tree varies from about 50 to 80 gallons or from 3 to 4 quarts a day. The young leaf-blades are used for making mats, fans, baskets, hats, buckets, olas, etc.; while the forked butt end of the leaf-stalk (" karku ") furnishes an excellent bristle- or brush-fibre, which forms an article of export, being valued in London at about 25*s.* per cwt. On an average 20 stalks yield 1 lb. of cleaned fibre, and a man can beat out 7–10 lb. of fibre per day.

In the north of Ceylon and parts of S. India, the Palmyra is the most important of economic palms; the area under this product in Ceylon alone is estimated approximately at 40,000 acres, while that in S. India is stated to be more than double that area. It is propagated from seed sown *in situ* in light alluvial soil, and no cultivation is given beyond protecting the young plants from cattle. In about 15 years from sowing, the palms should begin to flower, when, if the fruit is not required, they may be tapped for toddy, and this may be continued for 30–40 years. When grown for the fruit, it is estimated an average annual crop of about 200 nuts per tree may be obtained. The seedlings in many cases being allowed to grow up from self-sown seed, the palms often stand but a few feet apart. Thus the total outlay in ten years for bringing the trees into bearing is, on an average, estimated not to exceed about £1 per acre. Old palms at the age of 60 years or more yield a very hard and durable timber, used for building purposes, and formerly exported. (See *Fan Palms*, *Fibres*, and *Olas*.)

Sugar Sorghum; Imphee. (*Sorghum saccharatum.*)—A tall-growing grass, similar to Guinea-corn, sometimes cultivated for the sugar obtained from its stems, which is used chiefly in the preparation of sugar-candy. The plant, being somewhat hardier than the sugar-cane, may be profitably grown in a climate where the latter would not thrive. It has long been cultivated in N. India and more recently in the S. United States, for the production of sugar or syrup. Numerous varieties are recognised. Like the Guinea-corn, Sugar-sorghum may be grown in any ordinarily good soil, but thrives best on alluvial or sandy loam. It is benefited by manuring and in dry districts requires irrigation.

Sugar Maple. (*Acer saccharum.*)—A tree of N. America, the juice of which, obtained by tapping the stem in the spring, is rich in sugar, the yield being as much as 2–4 lb. of sugar per tree in a season. It is extensively cultivated in parts of Canada. **Beet-sugar** is obtained chiefly from a white-fleshed variety of Beet (*Beta vulgaris* var. *saccharatum*), grown extensively in Europe, including England.

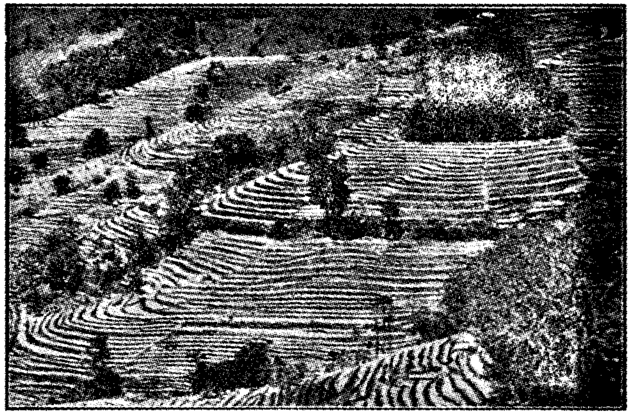
Sugar substitutes. The well-known substitute Saccharin is a coal-tar product, about 300 times sweeter than sugar, and used for sweetening the food of diabetic patients, also in the manufacture of aerated beverages. It has no food value.

Rice or **Paddy;** Goyan, *S*; Arisi or Arishi, *T*; Dhan (India). (*Oryza sativa.* Gramineae or Grass family.)—Rice is the staple food of the native population of tropical Asia, where the plant is indigenous and has been cultivated from time immemorial. Its cultivation has in more recent times been taken up in the warmer parts of S. America, W. Indies, S. Europe and elsewhere. The rice plant, known as paddy, is cultivated as an annual, growing from 2 to 5 ft. in height, according to variety, soil, and climate. Its grain (" Vee," *S*) furnishes a larger proportion of the food of the human race than does any other plant.

The area under rice cultivation in India and Burma alone is estimated at over 70 million acres, with a total estimated output of over 600 million cwts. Some 800,000 acres are estimated to be under rice in Ceylon, producing annually about 16 million bushels for local consumption, and about 430,000 tons of rice are imported annually from Burma, India and Siam.

Cultivation. For aquatic rice, a clayey loam overlying a porous subsoil (to facilitate the percolation of water) is considered by some to be the best, while others advise a clayey subsoil. Manuring is beneficial, crushed bones or bone-dust, at the rate of about 150–200 lb. per acre, being especially recommended. In India, green-

manuring by means of quick-growing annual crops is much practised, while in Ceylon, where green-manuring is less prevalent, leaves and twigs of various species, as *Aleurites triloba* (Rata-kekuna), *Cerbera Odollam* (Gon-kaduru), *Tithonia diversifolia* (Mexican Sunflower) and other kinds which may be convenient are spread on the surface and ploughed in. When water from streams or rivers is not available, it is raised by mechanical means, often primitive, from wells. In dry regions immense tanks or artificial lakes are constructed as reservoirs, the overflow from which supplies large tracts of irrigable land. Sloping or steep land is often rendered irrigable and suitable for rice cultivation by means of terracing, as in Ceylon (see *Irrigation*). Here, in preparing the land for sowing, water is first turned on to soften the soil, which is then either ploughed or roughly dug by mamoties or hoes and afterwards levelled with flat boards; or it is merely puddled by trampling teams of bulls or buffaloes, and then levelled. (See *Ploughing.*)



TERRACED PADDY (RICE) FIELDS IN CEYLON.
(See *Ploughing Paddy Fields*, p. 31.)

Sowing. Before sowing, the seed, which should be at least 6 weeks old, is usually soaked for 24 hrs., then heaped and covered with banana leaves or sacks and left for 5–6 days for initial germination to set in. In Ceylon the grain is generally sown broadcast at the rate of about 2–2½ bushels per acre. *Transplanted* rice, however, yields much greater returns, and only about a quarter the amount of grain used for broadcasting is required. In this case the seedlings are transplanted to the fields when 8–10 in. high (3–4 weeks after sowing), at distances of 4–6 in. apart, allowing 2–4 plants to each hole. The chief drawback to transplanting is the increased labour it involves. When the grain has sprouted well, the water is gradually turned on to the field, which is kept flooded until the flowers appear, when the supply of water is reduced.

THRESHING PADDY (RICE) BY MEANS OF TRAMPLING BUFFALOES.

Harvesting. When the grain is well formed, the water is turned off so as to hasten ripening and facilitate harvesting. This takes place in 3–7 months, according to variety, from the time of sowing, the shorter the period the smaller the crop as

a rule. Provided irrigation facilities are available two crops a year may be obtained in Ceylon, viz.: (1) the "Maha" crop (the principal one), usually sown in July–August and harvested in January–February; and (2) the "Yala" crop, generally sown in April–May and reaped in August–September. When the grain turns yellow, the crop is cut down with a sickle, dried in the sun, and tied in sheaves. Threshing in Eastern countries is often effected by primitive methods, as by the trampling of bulls or buffaloes tied together in teams and made to walk in a circle, the rice straw being thrown under their feet until threshed. The grain is afterwards winnowed in the wind, then stored. Hulling is done in wooden mortars when the grain is required for consumption. Where, however, rice is cultivated on a large scale or for export, machinery takes the place of hand labour to a large extent.

Yield. This varies considerably according to variety and mode of cultivation. It is appreciably increased by due attention to weeding, general cultivation, etc. The average yield for Ceylon is probably about 25 bushels per acre, though in some districts the yield is 60–80 bushels. The countries with the highest average yields are: Spain (101 bushels per acre), Japan (77), Egypt (73), Italy (63), British Guiana (54), Java (40), and India (30–40). One bushel of paddy weighs about 45 lb., and when hulled gives about ½ bushel of clean rice weighing about 30 lb. The whole production of rice in Ceylon is almost entirely in the hands of Ceylonese peasants.

SAGO PALM (*Metroxylon Sagu*). Showing suckers, also creeping stem behind man.

Imported rice comes under two heads, "raw" and "steamed." The former is imported chiefly from Burma, and the latter, which is steamed or parboiled and afterwards dried in the sun or in drying factories, mostly from India. Raw or "milled" rice takes longer to cook, and soon turns sour, when it becomes unpalatable and is considered to predispose the consumer to the disease of beri-beri.

Varieties. These are innumerable, there being about 500 reputed varieties in Ceylon alone. They come under two main types: (1) *Common, swamp* or *aquatic rice*, and (2) *Hill* or *Up-land rice*. To these may be added "*Perennial rice*," not cultivated in Ceylon. The first named is the most generally grown; it requires irrigated land and a hot climate, thriving up to about 3,000 ft. or higher in valleys. Hill rice thrives up to about 4,000 ft. The varieties are distinguished chiefly by size, form and colour of grain, height of plant, and cropping period. The last is an important character, some varieties producing a crop in about 3 months, while others take 6–7 months. Extra early maturity, however, is at the expense of yield, so that the medium between these is usually preferred. The following are some of the principal varieties grown in Ceylon:—

Cropping Period 6–7 *months*: Ma-vi, Muttusamba, Sudu-vi, Hatali.
5–6 *months*: Handeran, Honderawala, Hatiel, Sulai, Rata-vi, Puluk-samba.
4–5 *months*: Kalu-vi, Kuru-vi, Seenadi, Galkada, Giressa, Rathkundu.
3–4 *months*: Kalukanda, Kotiyaran, Kiri-kurumba, Sitharakali, Suwandel.
2½–3 *months*: Heenati, Kalu-heenati, Sudu-heenati, Bala-vi, Hetada-vi.
Hill rice or *El-vi*, which requires no irrigation, takes 4–5½ months to harvest, and yields from 25 to 40 bushels or more per acre, according to locality and soil.

Sago Palm; Rumbia.—The sago of commerce is obtained chiefly from the mature stems of *Metroxylon Sagu*, a palm with large pinnate

leaves and creeping or ascending stout stems, 30–40 ft. high, native of Malaya and usually occupying freshwater swamps. The palm is officially protected and often receives some cultural attention. It is propagated by suckers, which are generally found in various stages of development around the base of the older stems. Fertile seeds are seldom produced. The palm if left to itself will live about 15 years or more, the stem dying down after flowering. To obtain the sago the palm is felled when it begins to flower, usually at about 12–15 years of age.

The stem or trunk is then cut into sections 3–4 ft. in length, which are split lengthwise. The soft farinaceous matter is then scooped from the centre of these, and by a process of repeated washing and straining the starchy matter is separated from the fibre, then dried and made into sago meal, which by mixing with water is made into a paste. By pressing the latter through sieves with fine meshes, the granulated or "pearl" sago of commerce is obtained. England alone imports some 4,000 tons of sago annually, chiefly from Singapore and Sumatra. "Pearl sago" is quoted in London at about 25*s*.–30*s*. per cwt.

Yield. A single palm is said to yield from 120 to 200 lb. of marketable sago. In a well-managed Sago swamp, where the palms are thinned out to suitable distances, a continuous yield should be obtained without much, if any, replanting. The Sago palm was introduced at Peradeniya, Ceylon, in 1880, and flourishes there in moist, deep, alluvial soil. The trees flower freely and produce their globular, scaly and usually infertile fruit. Several varieties are recognised, these being either thorny or smooth-stemmed; the latter are generally considered to be the most prolific.

Sago Plant of Ceylon; Madu, *S.* (*Cycas circinalis.* Cycadeae.)—A palm-like plant, 8–15 ft. high or more, with handsome, long, feathery leaves. The large farinaceous seeds are ground and made into a useful sago by the low-country peasants of Ceylon. (See *Fol. Shrubs.*)

Tapioca. (*Manihot utilissima.*) (See *Cassava* or *Mandiocca.*)

CHAPTER XXVI

DRUGS, MEDICINAL PLANTS, MASTICATORIES AND POISONS

(1) *DRUGS.*
(2) *OTHER MED. PLANTS.*
(3) *PLANTS USED IN CEYLON NATIVE MEDICINE.*
(4) *SNAKE-POISON REMEDIES.*
(5) *MASTICATORIES.*
(6) *POISONOUS PLANTS.*
(7) *ORDEAL AND ARROW POISONS*

DRUGS

Tobacco ; Dhum-kola, *S* ; Poyile, *T*.—The tobacco of commerce in its various forms consists of the dried and cured leaves of varieties of *Nicotiana Tabacum*, a native of Trop. America and belonging to the Potato family (*Solanaceae*). The custom of smoking, introduced by Sir Walter Raleigh into England from America in 1585, is now universal. The plant is an erect annual, growing 5–6 ft. or more in height and bearing large, lanceolate, alternate leaves, characterised by viscous glandular hairs. It thrives in a tropical, sub-tropical, or warm temperate climate, and among the chief producing countries are : Cuba, S. United States, S. America, Egypt, Sumatra and S. Africa. The finest of all tobaccos is said to be produced in Cuba. Tobacco-growing forms a minor industry in Ceylon (some 13,000 acres), chiefly in the drier parts, the produce being largely used locally for chewing with betel and for local cheroots, but mainly for export to S. India.

Cultivation. The best soil for Tobacco is alluvial or sandy loam, rich in potash, lime and humus; stiff clay or gravelly soil is unsuitable. A warm humid climate with a well-defined dry season is best, the latter being necessary for harvesting. Flat or only slightly undulating land is desirable. The plant is a gross feeder, requiring good cultivation and liberal manuring. Cattle manure is considered by some the best, except when special qualities, as fine wrapper, is desired.

Propagation is by seed,* which is very small and should be sown in boxes under cover, or on smooth and covered beds. An ounce of seed should produce more than sufficient plants for an acre. When sowing, it should be mixed with sifted ashes or fine dry earth so as to enable its being sown evenly and thinly. The seedlings are planted out when quite small, that is at 6–8 weeks after sowing, when they should be 3–4 in. high. Planting out should be done late in the afternoon, spacing being about 3 × 2½ ft., or 6,200 plants to the acre, close spacing being desired for the production of fine qualities. The young plants are delicate and should be shaded with small twigs, fern-fronds, or grass, also watered, if the weather be dry, until well established, after which no shade of any kind is required. In about 5–6 weeks from planting, the flower buds will appear at the top of the plants; these as well as any side-buds must be nipped off, the operation being known as "suckering" ("dis-budding"), which has the effect of concentrating vigour in the leaves. The plants are then topped, leaving about 14 leaves to each, more or less according to the vigour of the plant. *Moulding*, or earthing up the plants, becomes necessary when the latter are about 3 weeks old. *Irrigation* once or twice a week or oftener may be necessary where the climate is dry.

Harvesting. About 3–4 months after the germination of the seed, the first leaves should be ready for cutting, this being indicated by their turning a yellowish-green with brown spots, the edges and tips curling downwards. Cutting should not be done when rain is on the leaves, nor when the sun is hottest. There are two methods of harvesting : (1) The whole plant may be cut near the ground when most of the leaves are mature, the stems with leaves attached being left on the ground for a few hours, so that the leaves may become pliable and less liable to be torn or broken ; (2) the leaves are cut separately as they mature, the two lower being removed at each round, say once in 5 or 6 days. Under good cultivation the plants should produce about 15 leaves each ; the number may, however, be as much as 20 or more. Generally speaking the first 6 or 8 leaves form the *best quality* and are preferred for "wrappers" ; the second lot *middle quality* ; and the top leaves *third*, the latter being used for "filler" or "chewing" tobacco. The grades are kept separate. After the plants are cut down, a "ratoon" or "sucker" crop may be obtained.

* 1 oz. contains about 400,000 seeds, but a considerable proportion are usually sterile.

Withering. The leaves being carried to the drying shed, they are threaded on a string fastened to a lath about 4 ft. long, each lath carrying 30–40 leaves. These are hung up in tiers in a specially constructed drying house to become partially dried. When the whole plants are cut down at once, the leaves are cut in pairs with a piece of the stem attached, and afterwards placed astride the drying lath. Drying or withering takes about 3 weeks, when the midrib becomes brown and soft.

FIELD OF "WHITE BURLEY" TOBACCO AT JAFFNA, CEYLON.

Fermenting or *Curing*, a most important process, follows, and upon this the proper development of the narcotic principle of tobacco largely depends. The leaves are tied in small bundles of about 50, and placed in piles on a wooden floor covered with dry leaves or sacks, all the butt ends pointing outwards and the tips toward the centre. The pile is left for about 5 or 6 days to ferment, when the temperature will have reached about 125° F. The pile should be turned at intervals ("breaks") of about 6 or 8 days for about 3 weeks, so as to equalise fermentation. Curing should be finished in about 22 days, but 5–6 weeks more are often allowed to complete the process of fermenting and drying.

Grading. The leaves are sorted according to length, colour, texture, etc. Various types of leaf are recognised, each being adapted to special requirements of the trade, as for wrapper, binder, filler, chewing, etc. Different qualities are often dependent on special conditions of soil and climate, as well as on specific characters of the plant. Wrapper-leaf for cigars should be thin, silky, almost tasteless, with the midrib removed ; whilst for filler purposes a heavy succulent leaf is preferred.

Yield. 800–900 lb. of cured leaf per acre is a fair average yield, though in some cases it is as much as 1,200–1,400 lb. In Ceylon the average yield is probably not more than about 650 lb. per acre. In India the yield is reckoned in maunds, about 1,000 leaves forming a maund (80 lb.).

Varieties. There are numerous varieties in cultivation, each producing country having stabilised special types. In Ceylon, "Jaffna" and "Dumbara" are regarded as distinct sorts, of which there are again recognised forms, as "Netti-dhunkola" and "Kon-dhunkola." In Jaffna, tobacco is produced under partial irrigation, the water being raised from wells by means of "well sweeps" (see p. 33). "White Burley," valued especially for high quality cigarettes, has given good results in

Ceylon, also "Mexican," a filler variety. Other well-known sorts are "Zimmer Spanish" (filler tobacco), "Virginian dark-leaf," "Sumatra," "Turkish," etc.

Buchu. (*Rutaceae.*)—A hardy evergreen shrub, native of S. Africa, where it is officially protected. The aromatic leaves yield a volatile greenish oil, used as a diuretic and for kidney trouble. These are furnished by three species, viz.: *Barosma serratifolia* (Kloof Buchu), *B. crenulata*, and *B. betulina* (Mountain Buchu). The last-named is the best. Buchu leaves are quoted in London at about 1*s.* 6*d.*–2*s.* per lb.

Cassia Fistula. Purging Cassia; Pudding Pipe; Ehela, *S.*—The long, cylindrical, black or brown pods, 1½–2 ft. long, are valued in medicine for their laxative properties, and exported from Java and the W. Indies (chiefly Dominica), being valued in London at about 25*s.* per cwt. The bark of the tree is esteemed in native medicine in India and Ceylon. (See *Flowering Trees.*)

Cinchona, Peruvian- or Quinine-Bark—also known as Jesuits' Bark. The alkaloids quinine, cinchonine, cinchonidine and quinidine are obtained from the bark of several species of *Cinchona* (Rubiaceae), which are small, erect trees, 25–40 ft. high, natives of S. America, chiefly Ecuador and Peru. The valuable curative effects of quinine in malarial fevers were first made known in 1638, when a preparation of the bark cured the Countess of Cinchon, wife of the then Viceroy of Peru, of malaria, the plant being afterwards named in her honour. Cinchona was introduced into India, Java and Ceylon in 1861. The Ceylon Government having established nurseries for it at Hakgala (now Botanic Gardens), issuing plants free of charge or at a nominal price, the planters took up its cultivation commercially in 1870.

Quinine or Cinchona Bark (*Cinchona succirubra*).

The area under the product rose rapidly from 500 acres in 1872 to 64,000 acres in 1883, the export of bark at its maximum output (1887) being nearly 16,000,000 lb. The great result was great over-production and a drop in the price of the drug from 15*s.* to 1*s.* 3*d.* per oz.—an immense boon to the public, but a disaster to the planters. The present price is about 2*s.* 6*d.* per oz. Cinchona bark has now practically disappeared from Ceylon's export list, and Java is the chief producing country. The Japanese have recently taken up its cultivation in Formosa. There are also plantations in India and Burma, worked by Government chiefly for the benefit of the peasants, to whom the drug is supplied in small packets at cost price.

Cultivation. The plant thrives best in a rich humous soil on a porous subsoil, preferring a cool mountainous or sub-tropical climate with a good rainfall (about 100 in. or more). *C. succirubra* is an exception and thrives at somewhat lower elevations and in a warmer climate. Propagation may be by cuttings, layering, or seed, the latter method being usually adopted. The seed is very minute, and should be sown thinly in boxes or on smooth nursery beds under cover, finely sifted soil being sprinkled over the surface before and after sowing. Watering should be done carefully through a fine rose. In about 3 weeks from sowing, the seedlings should be up, and when 2 in. high these should be transplanted to well-prepared nursery beds, so as to harden them, the shade being gradually reduced; when 8–9 in. high they may be planted out in their permanent places. Spacing may vary according to variety and locality. Close planting (4 × 4 ft.) at first, and gradually thinning out the weaker plants until only about half the original number are left, is considered preferable to wider planting at the commencement. The uprooted trees afford a return, the bark being stripped from the stem and roots. Root-bark is considered the most valuable.

Harvesting. To obtain the bark, different methods are employed: (1) *lopping*, by which the branches are lopped and the bark removed; (2) *coppicing*, the trees being cut down to the ground when about 6 years old, and the stems barked; this induces the production of other stems from the root which in turn are cut down and barked; (3) *shaving* the stem by means of a spoke-shave, care being taken not to reach the cambium; only two sides of a tree are shaved at once; (4) *mossing*, after the bark of trees 7 or 8 years old is removed in alternate strips, each 1½ in. wide, the stem is protected by a covering of moss tied on; thus in about 2 years the renewed bark, which is richer in quinine than the first bark, is again ready for removal. Of these, the second and third methods are the most generally adopted on plantations. The peeled bark is dried gradually in the sun, and exported in bales, the various forms being kept separate, as "root-bark," "flat-bark," "quill-bark," and "shavings." 600 lb. of dry bark per acre a year, or 2 lb. per tree (at 7 years old), is considered a good average yield.

Species, etc. C. succirubra (Red Bark), a tree 40–50 ft. high or more, with large, broad leaves; is hardy, easily established, suited to a wide range of climate, and semi-naturalised on some up-country estates in Ceylon; *C. officinalis* (Crown Bark), a slender tree, 20–30 ft. high, with small, narrow leaves; *C. Calisaya* (Yellow Bark), a valuable species, with a stout stem when full grown, not easily established; *C. Ledgeriana* (Ledger's Bark), especially rich in quinine, but the tree is comparatively small and best suited to medium elevations; it is rather delicate and requires special care in the young state; largely grown on Government cinchona plantations, Bengal. To these may be added certain superior hybrids. Cinchona substitutes include Cascarilla Bark (*Croton Eluteria*), Cuprea Bark (*Remijia* spp.), Angostura Bark (*Galipea officinalis*), and Bitter Bark (*Petalostigma* sp.) (*q.v.*).

Cocaine or Coca Plant (*Erythroxylum Coca*).

Coca or Cocaine-plant; "Spadic." (*Erythroxylum Coca.* Erythroxylaceae.)—A small shrub, 6–10 ft. high, indigenous to Peru and Bolivia and found at elevations of 4,000–5,000 ft., introduced to Ceylon in 1870. Extensively cultivated in its native habitat, where the leaves are largely used as a stimulant and masticatory (see p. 367), or exported for the extraction of the alkaloid cocaine. The plant thrives at elevations of 1,000–3,000 ft. in Ceylon, where small areas were successfully established until its cultivation was prohibited in the British colonies in 1914.

Cultivation. The plant thrives in ordinarily good friable soil, with a humid atmosphere and an evenly distributed rainfall not under 75 or 80 in. Shade is not essential after the plants are well established. The seed, which is rather difficult to germinate, must be sown fresh, preferably under cover and in plant-baskets, the

seedlings being afterwards planted out at distances of about 5 × 4 ft. In S. America, a method sometimes adopted in germinating the seed is to place them when fresh in a heap covered with wet sacks, thus setting up initial fermentation, being afterwards sown in the field *in situ*; in other cases they are sown at once in the field, 4–5 seeds to the hole, the ground being then covered with grass-litter or leaves, and the seedlings afterwards thinned out as desired.

Harvesting. The first plucking of leaves may be obtained when the plants are about 2½ years old from seed. Several pluckings are afterwards made in the year, the mature leaves only being, as far as practicable, selected. These are best dried in the shade, as in open airy sheds, so as to retain their green colour as much as possible. Sun-dried leaves become too shrivelled, lose a large proportion of their alkaloids, and therefore command a lower price. The dried leaves are said to be best packed for export in zinc-lined, air-tight cases. Usually, however, the dried twigs with leaves (the bushes being clipped with shears) are made up in pressed bales, which are covered with hessian, for export. An annual return of about 1,500–2,000 lb. or more dried leaf per acre may be obtained, and the shrubs will continue to yield for several years.

In the native home of the plant the leaves are, as already stated, very largely used as a masticatory, being chewed with a little unslaked lime; the immediate effect is said to be a "gentle excitement with sensations of high enjoyment, lessening the desire for food and enabling the consumer to undergo considerable fatigue." The leaves are also sometimes infused as tea, the infusion being taken as a stimulating drink. Since the restrictions of opium consumption in India, cocaine has occasionally been smuggled into that country for use as a substitute for opium. The value of the dried leaves, though largely judged by appearance, depends on their percentage of alkaloid. It is estimated that 100 lb. of dry leaf should yield about 1 lb. of alkaloid, which is usually valued at 30*s*.–40*s*. per oz. The price of the dried leaf fluctuates, according to quality and demand, from about 1*s*.–1*s*. 6*d*. per lb. in London. The export of Coca leaves from Ceylon in 1911 was 1,432 cwt. Since the prohibition of the cultivation of the plant in British colonies, the area under the product in Java has more than trebled, the chief buyers being Great Britain and the United States.

Varieties. Two forms of Coca leaves are recognised in commerce, viz. "Huanuco" or Bolivian Coca (*Erythroxylum Coca*), and "Truxillo" or Peruvian Coca (*E. truxillense*). The former was grown in Ceylon and became known on the market as "Ceylon Huanuco," whilst the latter is the type usually cultivated in Java. The leaves of an allied species (*E. lucidum*) Bata-kirilla, a large shrub of Ceylon, are used by the natives in medicine (*q.v.*), but they have shown no interest in Coca leaves.

Calumba or **Colombo-root.** (*Jateorhiza palmata.* Menispermaceae.)—A climber with palmate leaves, producing annual herbaceous stems, native of Mozambique and the Zambesi region. The fleshy tuberous roots, produced in clusters and yellow in section, are commonly used by the local inhabitants as a remedy for dysentery. Cut across into slices and dried, they are exported, being used in European medicine for their tonic and astringent properties, and now quoted at about 27*s*. per cwt. The common name is considered to have been derived from the fact that the root was first imported into Europe through Colombo. The plant was introduced at Peradeniya about 1890, but failed to become established. Efforts made in 1805 and at other dates to introduce it into Bengal, Bombay, etc. also failed.

False (or Ceylon) Calumba-root. Weni-wel, *S.* (*Coscinium fenestratum.* Menispermaceae.)—A woody climber with smooth bark, large roundish leaves with prominent 5–7 nerves, native of Ceylon and Malacca. The wood is of bright yellow colour, and is valued as a bitter tonic by the Sinhalese; it is also used as a cure for tetanus, and a yellow dye is obtained from it. The stems, cut into transverse slices or in short lengths, are sometimes exported from Ceylon. They can be distinguished from the true article by the sections being flat on the surface (not depressed) and woody, instead of being starchy as in *Jateorhiza*.

Croton-Oil; Purging Croton; Jayapala, *S.*—This powerful purgative and vesicant, commonly used in medicine, is extracted from the seed of *Croton Tiglium* (Euphorbiaceae), a small tree, native of India and China and suited to a moist tropical climate, up to 2,000 ft. It is not particular as to soil, and may be cultivated as a pure crop or as an intercrop, as with Cacao or Coffee, at the same time affording shade. It begins to bear in 3 years after planting, yielding 2 or 3 cwt. of seed per acre. When in full bearing, at the age of about 6 years, the yield may be 6–8 cwt.

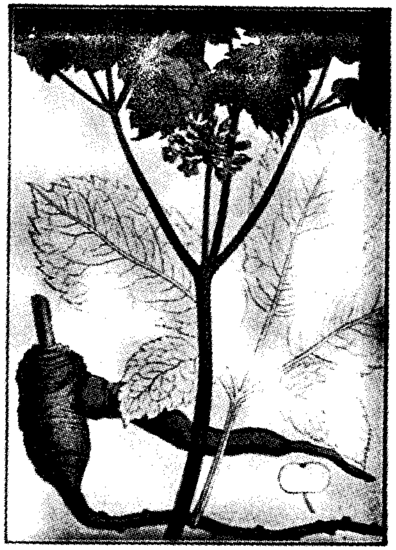
or more. The market value of the seed fluctuates considerably, the demand being very irregular. The export of the seed from Ceylon in 1933 was 73,150 cwt., averaging £5 10*s*. per cwt. They are now (1934) quoted at about 27*s*. per cwt. against £6 a year ago. The crop is in season chiefly in November–December. The trees are sometimes attacked by a caterpillar pest (*Amyna punctatum*). See *Insecticides*.

Cubebs (*Piper Cubeba*).

Cubebs. (*Piper Cubeba.* Piperaceae.)—The cubebs of commerce, of importance chiefly in medicine, are the berries of a species of a pepper-vine, easily distinguished from the ordinary pepper by the stalked and rather larger berries or "corns." The plant is indigenous to Java, Sumatra, etc., and was introduced to Ceylon in 1885. It thrives under similar conditions as Pepper, requiring live or artificial supports and a certain amount of shade. The demand for cubebs is limited and supplied by Java, where the plant is cultivated. The crop thrives at Peradeniya, where the vines are grown on trees of *Erythrina indica* and bear fruit freely. Propagation is by cuttings taken from the top or fruitful shoots, the plants thus raised being more productive than those taken from near the base.

Ginseng. The Chinese name for *Aralia* (*Panax*) *quinquefolia.* (Araliaceae.)—A small herbaceous plant with palmate leaves, native of China, cultivated as a Government monopoly in Corea, where the dried root forms one of the principal articles of export to China. The crop is grown under the protection of a light framework, and the roots are prepared for export by steaming for about 4 hrs. in wicker baskets placed over boiling water. Ginseng root is highly valued in China as a tonic and stimulant, and is sometimes sold at from "250 to 500 times its weight in silver."

Chinese doctors ascribe miraculous powers to it, possibly from its supposed resemblance to the human form, claiming that it wards off disease and restores exhausted animal powers, even "making old people young." The root is slightly bitter and aromatic, but is disregarded in European medicine. A form of Ginseng is furnished by a similar species found in N. America which is cultivated to some extent in the U. States, where the roots have been sold at from 2 to 4 dollars per pound for export to China as a substitute for the Eastern product. This variety is ranked by the Chinese as third or fourth quality, next to which being Japanese Ginseng, which is the least esteemed. The best quality is "Manchurian Imperial," next to which is the "Red Ginseng" of Corea. The plant thrives in rich, friable soil and requires light shade as well as a moderate amount of moisture.



Ginseng (*Aralia quinquefolia*). Showing bifurcated root, valued in Chinese medicine.

Ipecacuanha. (*Cephaelis Ipecacuanha.* Rubiaceae; sometimes placed under the generic names *Psychotria* or *Uragoga*.)—A small perennial herb with semi-creeping stems, 12–15 in. high, indigenous to dense humid forests of Brazil. From its annulated

roots an alkaloid (*emetine*) is obtained which is valued in medicine as an emetic, also as a specific for amoebic dysentery and as a stomachic tonic.

Cultivation, yield, etc. The plant is of very slow growth and does not respond readily to cultivation. The best conditions for it are a moist and hot climate, permanent shade, protection from strong winds, and a humous and well-drained soil. In planting, the ground should be dug to a depth of at least 15–18 in. and well broken up near the surface. Propagation is by roots or stem-cuttings, rarely by seed. It is best to plant in slightly raised beds, spacing being about 10 × 10 in. The roots are ready for harvesting about 2½ years from planting, and the yield may average from 2 to 3 oz. of marketable root per plant. The plants should be carefully dug from the ground, the roots thoroughly washed and dried in shade. The supply of the root comes chiefly from the forests of Brazil, and is said to be sometimes adulterated with other roots of similar appearance. England alone takes 60,000 lb. a year of the root, which fluctuates in price from about 5*s*. to 6*s*. or more per lb. The Ipecacuanha plant, first introduced to Ceylon in 1866, thrives in Heneratgoda

IPECACUANHA (*Cephaelis* (*Psychotria*) *Ipecacuanha*).
Showing annular roots, highly valued in medicine.

Botanic Gardens, near sea-level, under the natural shade of jungle. It is sometimes grown successfully on rubber plantations in Malaya, where it has been estimated to give a yield of at least 50–60 lb. of roots per acre every second or third year.

Ipecacuanha substitutes. See p. 363.

Nux-vomica. Goda-kaduru, *S*; Kanchurai, *T*; Kuchla of India. (*Strychnos Nux-vomica*. Loganiaceae.)—A moderate-sized tree with opposite, shiny, 5-nerved leaves, indigenous to Ceylon (chiefly in forests of the dry region), India, and Burma.

NUX-VOMICA (*Strychnos Nux-vomica*). (1) Fruit; (2) unripe fruit in section; (3) dried seeds.

The flat, circular, ash-grey, poisonous seeds, produced chiefly from August to November, are collected from forest trees and exported, being the source of the alkaloids strychnine and brucine, both powerful poisons, but valued in medicine as a tonic and stimulant. Ceylon and S. India are the chief, if not the only, sources of supply. 1,307 cwt. of the seeds were exported from Ceylon in 1923, valued at Rs. 22,053 (= about 21*s*. per cwt.). The seeds are now quoted in London at about 14*s*. per cwt. The globular fruit is of the

size of a small orange, yellow when ripe, and contains a mass of soft pulp, upon which monkeys and certain birds feed. (See *Poisonous Plants.*)

Opium, a well-known and valuable narcotic drug, the history of which dates back to B.C., is obtained from the milky juice of the unripe fruit capsules of the Opium Poppy (*Papaver somniferum*. Papaveraceae), an annual herb, native of India and Asia Minor, where, as well as in China, it is extensively cultivated under official control.

The drug is obtained by making slight incisions in the green, unripe fruit, from which the milky-white juice exudes; this should be done in dry weather, in the evening; by the morning the juice will have coagulated on the fruit, and is then collected and made into balls, which form the ordinary opium of commerce. From this, morphia, the active principle, is obtained. The yield of opium under cultivation averages about 20 lb. per acre. The price of the article fluctuates considerably, as from about 15*s*. to 30*s*. or more per lb., according to purity, etc. The small seed is sown in drills 2 ft. apart, afterwards allowing 9 in. between the plants in the drills. The plants blossom in 2½–3 months from planting. The petals are removed from the flowers, and about 12 or 15 days later the fruit capsules are ready for "tapping," as above described, for the collection of opium.

There are two distinct varieties of the Opium-poppy, viz., var. *glabra*, which furnishes medicinal opium (morphia, etc.) and is grown chiefly in Turkey and Persia; and var. *alba*, which is cultivated mainly in India and China and furnishes the opium used for eating, drinking, or smoking. Considerable restrictions have in recent years been placed on the consumption of opium in Eastern countries, and only registered consumers can now be supplied with the article, except as prescribed by a medical man. A large number of people, however, take the drug habitually.

Peppermint. (*Mentha piperita*. Labiatae.)—An erect perennial herb, 1–3 ft. high, with a strong aromatic odour, cultivated in Europe and elsewhere for Peppermint oil. This is distilled from the shoots and leaves, is largely used in confectionery and medicine, being antiseptic, stimulant and carminative. It is also used in perfumery, and is the chief ingredient in a well-known liqueur. Menthol, a white crystalline substance used in numerous preparations, is obtained from the oil. *M. arvensis* furnishes Japanese Peppermint, which is similarly employed. The oil is quoted in London at 4*s*., and menthol at about 10*s*. per lb.

Sarsaparilla.—A drug used especially for rheumatism, gout, etc., obtained from the roots of various species of *Smilax* (Liliaceae), which are climbing plants, characterised by more or less prickly stems and large, ovate, 3-nerved leaves, found in a wild state in the W. Indies, Mexico, etc. *Smilax officinale* furnishes the Jamaica Sarsaparilla, while other species supply the Brazilian and Mexican product. The former thrives at Peradeniya, Ceylon, where it was introduced in 1880. Several species of *Smilax* are indigenous to the moist region of Ceylon, up to about 4,000 ft., but none of these appears to be used medicinally. Propagated by suckers or seed.

The collection of Sarsaparilla is effected by scraping away the earth from the roots, which run horizontally under the ground; when laid bare, these are cut off near the crown, a few slender roots being allowed to remain to assist the plant in carrying on its growth. The collected roots are then dried and packed in bundles for export. Jamaica Sarsaparilla is now quoted in London at 1*s*. 6*d*. per lb.

Indian Sarsaparilla; Iramusu, *S*. (*Hemidesmus indicus*. Asclepiadeae.)—A small, slender, twining plant, found wild in the moist low-country of Ceylon, also in India, etc. The roots are much used as a tonic, being included in the British and Indian pharmacopoeias.

Senna (Pods or Leaves).—The dried pods or leaves of certain species of Cassia are much used in medicine for their mild laxative properties. "Alexandrian Senna," the best known in commerce, is furnished by *C. acutifolia*, cultivated in Sudan, etc. and formerly exported from Alexandria but now from Port Sudan. The next best is "Tinnevelly Senna" (*C. angustifolia*), cultivated to some extent in S. India. Both are shrubby plants, about 3 ft. high, native of Arabia, Sudan, etc. *C. obovata* of N. Africa furnishes an inferior senna and has become naturalised in Jamaica. The unripe pods are now mostly used instead of the leaves. The former

are now quoted at about 2*s*.–6*s*. per lb. in London, and the latter at about 4*d*.–6*d*. The yield of senna-leaves per acre in S. India has been estimated at 700–900 lb. a year.

Tamarind (see *Orn. Fol. Trees*).—The brownish pods, containing a mass of sweetish acid brown pulp, form the "Tamarind" of commerce, which is largely used in the preparation of cooling beverages, also in European as well as in native medicine and as a seasoning for chutneys, preserves, etc. The pulp is pressed and preserved in large masses, being commonly sold in the kaddies or bazaars by weight. In the north of Ceylon it is made into a brine for preserving fish. The principal season for the fruit is January–February.

Thymol.—A valuable antiseptic crystalline substance, quoted at 6*s*. per lb., obtained from Ajowan- or Ajava-oil, which is derived from the "seeds" (small fruits) of *Carum copticum* (Umbelliferae), a small herb. The latter is cultivated in India, more especially in Bengal, as a cold-weather crop. The seeds are used in India as a condiment and in medicine, being valued as a cure for indigestion. They are quoted at from 40*s*. to 50*s*. per cwt. Thymol is used for hookworm, etc.

TAMARIND (*Tamarindus indica*). Pods used in medicine and as a spice.

OTHER DRUGS AND MEDICINAL PLANTS

Angostura Bitters or **Cusparia Bark.** (*Galipea officinalis.* Rutaceae.)—A Brazilian tree, 15–20 ft. high. The bark yields the well-known aromatic bitter tonic Angostura, and was formerly used in place of Cinchona bark.

Artemisia Absinthium. (Compositae.) Wormwood.—An oil distilled from it is used medicinally and formerly formed the chief ingredient in the French liqueur Absinthe, now prohibited. *A. Abrotanum* is the highly fragrant shrub known as "Southern Wood."

Asafoetida. (*Ferula foetida.* Umbelliferae.)—A herb. plant of Persia and N. India. The tuberous root yields a gum-resin with an offensive odour; exported in small lumps and used in medicine as a stimulant; also used in Persia as a condiment.

Canella Bark; White-, Wild-, or Jamaica Cinnamon. (*Canella winteriana.*) —Bark exported from Bahamas for use in medicine. (See *Spices*.)

Cascara-sagrada. (*Rhamnus purshiana* and *R. californica.* Rhamnaceae.)—N. American shrubs. Extract from bark forms a well-known aperient. Bark 2–3 years old or more commands the highest price, being quoted in London at 31*s*. or more per cwt.

Cascarilla Bark. (*Croton Cascarilla* and *C. Eleuteria.* Euphorbiaceae.)—Shrubs or small trees of the Bahamas. The aromatic bark is a well-known bitter tonic, without astringency. *C. niveus*, Copalchi Bark. Venezuela. Used as a drug.

Cassia beariana. (Caesalpineae.)—Small tree of Cent. Africa, where the roots are used by the natives as a cure for black-water fever.

Cedron Seeds. (*Simaba Cedron.* Simarubaceae.)—A small tree of Cent. America. Seeds exported for med. purposes, being febrifuge, tonic, and sedative.

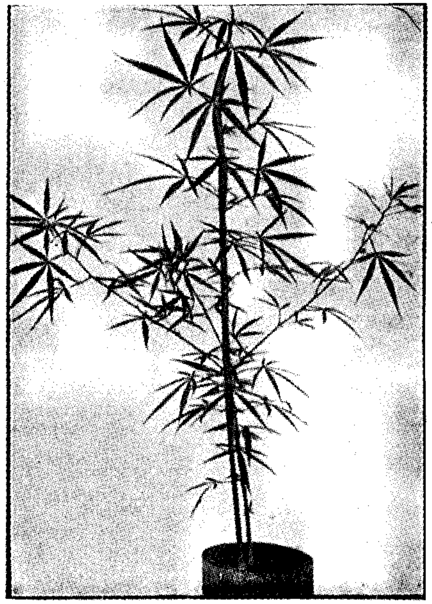
Conessi Bark. (*Holarrhena antidysenterica.* Apocynaceae.)—Small tree of India and Burma. Leaves, fruit, seeds and bark used medicinally, the latter especially being valued in the treatment of dysentery.

False Jalap, Turbith or Turpeth, is furnished by *Ipomoea Turpethum* (*q.v.*).

Ficus doliana and **F. laurifolia.** Extract from bark used in Brazil, Venezuela, etc., for hookworm (*anchylostomiasis*).

Ganja, Bhang, Charas, Kansa, Dagga (S. Africa). (*Cannabis sativa.* Moraceae.)—A dioecious annual, 4–6 ft. high or more, the leaves, stems, and inflorescence of which are strongly narcotic and often used in the tropics as a drug or stimulant, being smoked with tobacco or in cigarettes, etc. The narcotic principle is a gum-resin, developed to greatest extent in the unfertilised flowers of the female plant, so that when grown for the drug the male plants are pulled up as soon as they can be distinguished. The drug occurs in several forms, as *ganja* (consisting of the pressed flowering tops), *bhang* (leaves and flowering shoots together), and *charas* (the gum-resin found on the stems). The latter is the most powerful. An intoxicating liquor (*hashish*) is also prepared from the plant.

The drug has a hypnotic or sedative effect like that of opium. In small portions it produces excitement, passing into delirium and catalepsy with increasing quantities. The names given to the plant indicate "leaf of delusion," "increaser of pleasure," and "cementer of friendship." Its cultivation is subject to stringent restriction in most tropical countries or to total prohibition in some, *e.g.* Ceylon. The drug is often smuggled into Ceylon from India in compressed 1 lb. slabs, which fetch from Rs. 40 to Rs. 150. These are cut up into small squares for retail dealers. Most addicts of the drug begin by appreciating its soothing effect after a hard day's work, and later become victims to its insidious demand. (See also *Fibres*.)



GANJA OR BHANG (*Cannabis sativa*).

Henbane. (*Hyoscyamus niger.* Solanaceae.)—Native of Europe, N.W. India, N. Africa, etc. Annual or biennial, 2–3 ft., narcotic and poisonous. Seeds, leaves and green tops yield the alkaloid *hyoscyamine*, used as a sedative, etc. Indian Henbane (*H. muticus*) has similar properties and is sometimes used in India for smoking.

Ipecacuanha, False. (*Asclepias curassavica.*) — An erect, perennial, semi-herbaceous shrub. Root emetic and cathartic, used in W. Indies for piles and gonorrhoea. The roots of *Ionidium Ipecacuanha* (Violaceae), known in Brazil as "White Ipecacuanha," are also used as a substitute for ipecacuanha, while those of *Tylophora asthmatica* have similar properties.

Jaborandi. (*Pilocarpus Jaborandi* and *P. pinnatifolius.* Rutaceae.)—Shrubs with pinnate leaves, natives of Brazil. The dried leaves yield the alkaloid *pilocarpine*, used for medicinal purposes, being stimulant, diaphoretic and expectorant.

Jalap. (*Ipomoea purga.* Convolvulaceae.)—Mexico. Climbing shrub, bearing tubercled roots which yield the powerful purgative known by this name. Requires rich humous soil with shade and a wet montane climate. A crop may be obtained every third year, yielding about 1,000 lb. dried tubercles, which are valued in London at about 1*s*. 6*d*. per lb. Cultivated in S. India for export.

Koso. (*Brayera sp.* Rosaceae.)—A shrub, the dried flowers of which are used in Abyssinia, Arabia, etc. as a purgative and for expelling tapeworm.

Macassar Kernels. (*Brucea sumatrana.* Simarubaceae.) Kaputu-gedi, *S.*—Slender shrub of Assam, Malaya, etc., 4–5 ft. high. Whole plant bitter. Seeds known as Macassar Kernels, much used in Java for dysentery. Nat. in Ceylon.

Manna of commerce. (*Fraxinus Ornus.* Oleaceae.)—A small ornamental tree of Asia Minor, etc. Yields a gummy exudation from incisions made in the stem which is valued in medicine as a mild laxative. "Manna" is also applied to a sweet powdery substance obtained from *Alhagi maurorum*, a leguminous shrub common in the deserts of Syria, Persia, etc. Tamarix Manna, a sweet powdery substance

produced on the twigs of *T. articulata* (*q.v.*) by puncturing insects and collected by shaking the branches over a cloth.

Musenna- or Bisenna-bark. (*Albizzia anthelmintica.*)—A small tree. Bark commonly used in Arabia, etc., as a vermifuge.

Myrrh ; Balsam of Mecca or Balsam of Gilead. (*Commiphora Myrrha.* Burseraceae.)—Stunted shrubs of Arabia and N. India. An oleo-resin from stems and shoots used for medicine, incense and embalming.

Quassia Wood ; Bitter Wood. Quassia Chips. (*Picraena excelsa.* Simarubaceae.)—A fairly large tree of the W. Indies. Wood largely exported from Jamaica for use as a bitter tonic; also used in insecticides and by brewers for hops.

Strophanthine ; Kombe. (*Strophanthus hispidus.*)—A climbing shrub of Cent. Africa. Extract from seed used for cardiac affections.

Withania coagulans. Panibrand. (Solanaceae.)—A small herbaceous shrub. Fruits used in India to coagulate milk when rennet is objected to on religious grounds.

Worm-seed. (*Chenopodium ambrosioides,* = *C. anthelminticum.*)—Annual herb. Oil obtained from fruit heads used in hookworm (anchylostomiasis) treatment. (See *Edible Herbs*; also *Essential Oils.*)

PRINCIPAL PLANTS USED IN NATIVE MEDICINE IN CEYLON

Abrus precatorius. Olindawel, *S*; Indian-liquorice. (*Leguminosae.*) Juice of green lvs. taken for "purifying the blood"; root taken for sore throat and rheumatism. See *Poisons.*

Abutilon asiaticum. Anoda, *S.* Root a tonic, also used for piles.

Acalypha indica. Kuppameniya, *S.* (*Euphorbiaceae.*) Vermifugal and carminative, also applied to sores.

Achyranthes aspera. Karal-sebo, *S.* (*Amarantaceae.*) Juice of lvs. taken for dysentery.

Acorus Calamus. Wada-kaha, *S.* Aromatic rootstock used in bowel complaints. See *Insecticides,* etc.

Adhatoda Vasica. Wanepala, *S*; Pavettai or Adatodai, *T.* (*Acanthaceae.*) Whole plant used in treatment of excessive phlegm; also in menorrhagia.

Aegle Marmelos. Bael-fruit; Beli, *S.* See *Trop. Fruits.* Unripe fruit boiled, freed from fibre and sweetened, is a well-known remedy for dysentery; also taken for piles.

Aerva lanata. Pol-kudupala, *S.* (*Amarantaceae.*) Valued for coughs; also as a vermifuge for children.

Ageratum conyzoides. Pum-pillu, *T*; Hulan-tala, *S.* Lvs. commonly used for cuts or sores.

Aloe vera, var. littoralis. Kattalai, *T.* (*Liliaceae.*) Fresh juice of lvs. cathartic and cooling; used in fever, spleen and liver troubles, also in eye diseases.

Alternanthera triandra. Mukunuwenna, *S.* Lvs. used as a local application for giddiness, etc.

Areca Catechu. Puwak, *S.* The nut is scraped and applied to ulcers; strengthens the gums, as in betel-chewing; also given for worms in animals.

Asparagus falcatus. Hathawariya, *S.* Tuberous roots commonly used in cooling medicines, also for venereal diseases, etc.

Azadirachta indica. Margosa; Kohomba, *S.* Lvs. and fruit vermifugal; fruit purgative; oil taken for rheumatism. See *Fixed Oils.*

Brassica juncea. Aba, *S*; Mustard. Seeds pungent, used as poultice in gout and inflammation; lvs. promote appetite. See *Oils.*

Caesalpinia Bonduc. Kumburu-wel, *S.* Tender lvs. applied for toothache; also given for worms in children.

Calophyllum Inophyllum. (*Q.v.*) Domba Oil; Domba-tel, *S.* Oil from fruit kernels used for ulcers and hoof disease of cattle; root and bark for rheumatic pains.

Calotropis gigantea. Wara, *S.* Green lvs. applied to dispel swellings. Root a tonic. Milk (latex) from stems used for leprosy. See *Fibres.*

Canscora decussata. (*Gentianaceae.*) Herb with yellow fls., found in wet places up-country; valued as a tonic.

Cardiospermum Helicacabum. Penela-wel, *S*; Muda-cottam, *T.* (*Sapindaceae.*) Roots and lvs. aperient; also used as hair-wash.

Cassia auriculata. Rana-wara, *S*; Matara Tea. Bark and root astringent, used as an alterative; dried lvs. used as tea. See *Tans,* etc. **C. Fistula.** Ehela, *S*; Pudding-pipe. (*Q.v.*) Fruit purgative; bark astringent; used for rheumatism.

Celastrus paniculatus. Duhudu, *S.* (*Celastraceae.*) Bark considered to "strengthen the brain and purify the blood"; oil from seeds used to cure sores.

Centranthera procumbens. Dutu-satutu, *S.* (*Scrophulariaceae.*) Small herb, used in fevers and externally for sore eyes. Roots bright orange-yellow.

Cissampelos Pareira. False Pareira Root; Diyamitta, *S.* (*Menispermaceae.*) Roots used in fever and diarrhoea.

Cocos nucifera. Coconut; Pol-gedi, *S.* Oil applied to head for cooling. Pulp of young fruit given in sun-stroke; root strengthens the gums.

Coleus aromaticus. Kappra-walliya, *S.* Decoction of lvs. given for asthma, chronic coughs, etc.

Coscinium fenestratum. See *Calumba Root.*

Crataeva Roxburghii. Lunu-warana, *S.* (*Capparideae.*) Lvs. used for gouty swellings; bark decoction sharpens the appetite.

Curcuma domestica (= **C. longa**). Kaha, *S*; Turmeric. Root used in skin diseases, also for sore eyes. See *Spices.*

Cyperus rotundus. Kalanduru, *S.* Decoction of tubers given in fever, diarrhoea, dyspepsia and stomach complaints. See *Weeds.*

Daemia extensa. Meda-hangu, *S*; Veliparatti, *T.* (*Asclepiadeae.*) Emetic; given as an expectorant in bronchitis.

Datura fastuosa. Attana, *S.* Roots used in bites from mad dogs; also for insanity. Lvs. smoked for asthma. See *Poisonous Plants.*

Eclipta alba. Kikirindi, *S.* (*Compositae.*) Lvs. taken to purify the blood.

Embelia Ribes. Wal-embilla, *S.* (*Myrsineae.*) Bark and lvs. acid and astringent, taken for boils and skin diseases.

Emilia sonchifolia. Kadupara, *S.* (*Compositae.*) Used for cuts and wounds.

Erythroxylum lucidum. Bata-kirilla, *S.* (*Linaceae.*) Lvs. chewed to expel worms, also to appease hunger. See *Coca.*

Euphorbia hirta (= **E. pilulifera**). Milk-weed; Dada-kiriya or Kiri-tala, *S*; Palavi, *T.* Small annual trailing weed, common in cultivated ground, especially in dry sandy soil. Whole plant considered a cure for asthma. Sometimes enquired about for export.

Evolvulus alsinoides. Visnukranti, *S* and *T.* (*Convolvulaceae.*) Whole plant a bitter tonic and febrifuge.

Feronia elephantum. Diwul, *S*; Wood-apple. Green fruit checks diarrhoea; ripe fruit taken for kidney affections. See *Trop. Fruits.*

Garcinia Cambogia. Goraka, *S.* Bark, lvs. and fruit used as laxative; also for cuts and wounds. See *Trop. Fruits.*

Gynura pseudo-china. Ala-beth, Cheena-ala, Mul-beth, *S.* (*Compositae.*) Tuberous roots used as a cooling medicine, also for leprosy.

Hemidesmus indicus. Iramusu, *S.* See *Sarsaparilla.*

Herpestis Monnieria. Lunuvila, *S.* (*Scrophulariaceae.*) Whole plant used as a mild purgative; also as fomentation for erysipelas and elephantiasis.

Hibiscus micranthus. Perumaddi, *T.* A valuable febrifuge. (Trimen.)

Hydrocotyle asiatica, Heen-gotukola; and *H. javanica,* Maha-gotukola. (*Umbelliferae.*) Lvs. a tonic and blood-purifier; also taken for indigestion, nervousness and dysentery. Small herbs, in moist shady places; the former up to 7,000 ft. Both much valued in native medicine.

Hygrophila spinosa. Katu-ikiri, *S.* (*Acanthaceae.*) Whole plant used for diabetes.

Ipomoea (Operculina) Turpethum. Turbith or Turpeth; False Jalap; Trastawalu, *S.* Twining creeper with 3- or 4-winged stems. The tuberous roots are used as a purgative; considered a good substitute for Jalap. Cultivated in peasants' gardens. "Doubtfully wild." (Trimen.)

Ixora coccinea. Ratmal or Ratambala, *S.* Fls. and bark used for blood-shot eyes; lvs. for sores, ulcers, etc.

Justicia Betonica. Sudhu-puruk, *S.* Lvs. used as poultices for boils.

Kaempferia Galanga. Hinguru-piyali, *S.* (*Scitamineae.*) Aromatic and stimulant, like ginger; much used in decoctions.

Lasia spinosa. Kohila, *S.* (*Aroideae.*) A common remedy for piles.

Limonia alata. Tumpat-kurundu, *S.* (*Rutaceae.*) Lvs. and bark used in fomentations for rheumatic pains.

Mimusops Elengi. Muna-mal, *S*; Mukalai, *T.* (*Sapotaceae.*) Large tree. Bark bitter and tonic, used in distillation of arrack, also for snake-bite.

Modecca palmata. Hondala, *S.* (*Passifloraceae.*) Juice of lvs. and roots used externally for skin diseases. See *Poisonous Plants.*
Moringa pterygosperma. Horse-radish Tree; Murunga, *S.* Bark, lvs. and root acrid and pungent, taken to promote digestion; used externally as a rubefacient. See *Trop. Vegetables.*
Mucuna pruriens. Achariya-pala, *S.* Climber. Seed believed to absorb the poison from a scorpion wound.
Munronia pumila. Bin-kohomba, *S.* (*Meliaceae.*) Whole plant very bitter and tonic; a good substitute for the tonic Chiretta (*Swertia Chirata*).
Musa sapientum. Plantain or Banana. Juice from lvs. taken as antidote for snake-poison. See *Trop. Fruits.*
Nelumbium speciosum. Nelun, *S*; Tamarai, *T.* Stamens used for bleeding piles and in parturition. See *Sacred Plants*, etc.
Ocimum sanctum. Maduru-tala, *S.* Aromatic herb, used in decoctions for coughs; sometimes chewed as a substitute for betel.
Operculina. See *Ipomoea Turpethum.*
Oroxylum indicum. Totila, *S.* (*Bignoniaceae.*) A tree. Bark a bitter tonic.
Oxystelma esculentum. Kulappalai, *T.* Twiner. Lvs. a cure for hydrophobia.
Phyllanthus Emblica. Nelli, *S* (*q.v.*). Fruits a cooling laxative.
Piper Betle. Betel-leaf; Bulat-wel, *S.* See *Masticatories.* **P. longum.** Tippili, *S.* Roots and dried flower-spikes used for dyspepsia.
Plectranthus aromaticus. Kapuru-waliya, *S.* (*Labiatae.*) Whole plant aromatic; used in medicine, especially for cattle. **P. zeylanicus.** Iri-veriya, *S.* Whole plant aromatic and carminative; used for dysentery.
Pongamia glabra. Magul-karanda, *S.* (*Leguminosae.*) Large tree. Juice of roots used for sores; also for cleaning the teeth and strengthening the gums.
Punica granatum. Pomegranate; Delun, *S.* Fruit astringent, taken for diarrhoea and other ailments. See *Trop. Fruits.*
Randia dumetorum. Kukuruman, *S.* Root decoction taken for indigestion.
Ricinus communis. Castor Oil; Tel-endaru, *S.* See *Fixed Oils.*
Saccharum officinarum. Sugar-cane. Juice commonly used in decoctions (*q.v.*).
Salacia reticulata. Himbutuwel, *S.* Decoction of roots given in diabetes.
Sesamum indicum (*q.v.*). Ella, *T*; Tel-tala or Wal-tala, *S.* Oil used for cooling the body. Seeds, pounded with jaggery, taken to purify the blood.
Solanum indicum. Tibbatu, *S.* Root much used for bronchitis, asthma, etc. Fruit edible. **S. xanthocarpum.** Ela-batu, *S.* Used for catarrhal fever, asthma, etc.
Spilanthes Acmella. Akmella, *S.* (*Compositae.*) Lvs. and fls. used for toothache and sore throat; also given to women at child-birth.
Strychnos potatorum. Clearing Seeds; Ingini, *S.* Seeds not poisonous; rubbed on inside of vessels, they are said to have the effect of clearing muddy water.
Tamarindus indica. Tamarind; Siyambala, *S.* Tender lvs. used as poultices for boils, also as fomentations; seeds used for diarrhoea. See *Drugs*, etc.
Tephrosia purpurea. Pila, *S*; Kavilai, *T.* Common village medicine for children. **T. spinosa.** Mukavaliver, *T.* Popular bazaar drug.
Terminalia Chebula. Chebulic-myrobalans; Aralu, *S*; Kadukkay, *T.* Bark and nut valued in treatment for fever, asthma, diarrhoea. See *Tans.* **T. belerica.** Bulu, *S*; Beleric-myrobalans. Nuts very astringent; used in eye disease, etc. See *Tans.* **T. glabra.** Kumbuk, *S*; Marutu, *T.* Very large tree. Bark astringent, rich in lime, commonly burnt for obtaining the latter for use in betel-chewing.
Tinosperma cordifolia. Rasa-kinda, *S.* (*Menispermaceae.*) Twiner; lvs. and bark used in fever, skin diseases, jaundice, and syphilis.
Trichadenia zeylanica. Tolol, or Titta-totol, *S.* (*Bixaceae.*) Oil from seed used in skin disease and for burning.
Trichosanthes cucumerina. Dummella, *S.* Root decoction taken as a vermifuge; lvs. and stems used in decoction for bilious disorders, cutaneous diseases, and as an emmenagogue.
Tylophora asthmatica. Bin-nuga, *S.* (*Asclepiadeae.*) Roots possess similar properties to Ipecacuanha (*q.v.*).
Vernonia anthelmintica. Sanni-nayan, *S.* Used for fever convulsions. **V. cinera.** Monara-kudumbia, *S.* Used for wounds; also a diaphoretic.
Vitex Negundo. Nika, *S.* Lvs., bark and roots used for toothache, rheumatism, eye disease, and as a tonic; also carminative and vermifuge.

Withania somnifera. Amukkara, *S.* Used for cough and asthma (*q.v.*).
Zinziber officinale. Ginger; Inguru, *S.* A well-known stimulant and aromatic; taken for indigestion, fever, etc. See *Spices.*

SNAKE-BITE REMEDIES

The following and many others are of reputed value in snake-bite remedies: *Aristolochia spp.* (root); Banana or Plantain (juice of leaves and stem applied to wound); *Gynandropsis pentaphylla* (pounded leaves); Lime or Citrus (juice of fruit); *Martynia diandra*, "Naga-darana," *S* (leaves and fruit); *Mimosa pudica*, Sensitive Plant (root and leaves); *Mimusops Elengi*, Muna-mal (decoction of bark and leaves); *Ophiorrhiza mungos*, Mongoose Plant (leaves said to be chewed by mongoose as an antidote to poison after a fight with a cobra).

MASTICATORIES

Areca-nut Palm (*Areca Catechu*). Showing coolies climbing palm for the nuts.

Areca-nut or **Betel-nut**; Puwak, *S*; Pak-ku, *T*; Pan of India. (*Areca Catechu.* Palmae.)—A tall, slender, erect palm, 30–50 ft. high, native of Malaya, extensively cultivated in Ceylon and throughout tropical Asia for its "nuts" (seeds), which in the husk are each about the size of a hen's egg, yellow or orange-yellow when ripe. The brown, conical "nut" is commonly used throughout the Eastern tropics as a masticatory. In preparing this a few thin slices of the nut are taken, to which is added a dash of lime-paste and a small portion of tobacco leaf, all being wrapped in a leaf of the Betel vine (see *Betel-leaf*) to form a pellet for chewing. A cardamom or two are sometimes added to make the chew more palatable, as on ceremonial occasions. The effect is stimulating and lessens the desire for food. Ground into powder, the nut is commonly used as a vermifuge for dogs and other animals; also used in the preparation of dentifrices.

Cultivation and yield. In Ceylon the Areca-nut palm thrives in the moist low-country, up to about 3,000 ft. in moist valleys. It requires little or no cultivation when once established, seedlings being planted closely (sometimes allowed to grow up spontaneously, like the Palmyra), generally mixed with other trees or crops. The palm requires but little space, and an acre may contain as many as 1,800 trees or more, *i.e.* if spaced about 5 × 5 ft. It takes 6–8 years to come into bearing, and at maturity an annual yield of about 200–250 nuts per palm, or about 8–12 cwt. per acre may be obtained, according to variety and locality. The trees continue productive for 25 years or longer, and may live for several years afterwards. The area under Areca-nuts in Ceylon is estimated to be equivalent to about 75,000 acres, practically all owned by peasants. In addition to local consumption, some 5,000 tons of the nut are exported annually from Ceylon, chiefly to India, and fetch about 18*s.* per cwt. The palm may be seen in almost every native garden, and is often

planted closely in boundaries, for which purpose it is well adapted. Among varieties, "Hamban-puwak," with a longish ovoid nut, and "Rata-" or "Batavia-puwak," with a large roundish nut, are well known. "Karunka" is the dried, ripe, husked (decorticated) nut, about 10,000 of which go to a cwt. Tender unripe nuts, cut into thin slices, are known as "Kali" and, being more astringent than the ripe nut, are sometimes preferred for chewing; these are also used in medicine.

Betel-leaf; Bulath-vel, *S*; Veth-thilé, *T*; Pan (India). (*Piper Betle*. Piperaceae.)—A perennial, evergreen climber or creeper, with large heart-shaped leaves, indigenous to Ceylon, India, and Malaya, cultivated throughout tropical Asia for the sake of the leaves. The latter are universally used in the Eastern Tropics for chewing in a green state, forming the masticatory commonly known as "betel" ("bulath," *S*), the other ingredients being lime, areca-nut, etc. (see above). The leaves have a sharp pungent taste and sustaining properties.

Betel Vine (*Piper Betle*).
Leaf much used as a masticatory.

The habit of betel-chewing is considered advantageous to a people whose ordinary food includes but little or no flesh, providing the antacid, tonic, and carminative which they require (Emerson Tennent). The plants require a rich, humous, moist soil and a partially shaded situation. They are readily propagated by cuttings, which may be planted against poles, trellises, or tree-trunks for supports, and are generally grown in enclosed "gardens" or squares, which are strictly guarded. In India, the plant is cultivated in low sheds or "betel houses."

Varieties. In addition to the ordinary type, the following varieties are known in Ceylon: "Rata Bulath-vel" or "Siribo Bulath"; "Naga wallibulath" (with variegated leaves); "Getatodu-bulath"; "Mala-bulath"; "Gal-bulath"; "Gas-bulath"; and "Dalu-kotu-bulath."

Kola-nut; Bissy- or Gooroo-nut. (*Cola acuminata*. Sterculiaceae.)—A tree of W. Trop. Africa, 30–40 ft. high, with large ovate-acuminate, leathery leaves, introduced and sometimes cultivated as a minor crop in the W. Indies (where it is naturalised), Ceylon (introduced in 1879), Malaya and other tropical countries. It bears stout, warty, green pods, 5–7 in. long, containing 6–10 or more large, pink, purplish or white seeds, which become dark brown on drying. The nuts (seeds) have stimulating and sustaining properties, due to the presence of 2% of caffein (*kolatine*), and are a popular and universal masticatory throughout Central and N. C. Africa. They are imported to some extent into Europe and other countries, and used in various preparations, as kola-wine, kola-chocolate, in medicine, etc., but the demand is at present limited. The Kola-nut ranks next in importance to the Oil-palm (*Elaeis*) in W. Trop. Africa. From the Gold Coast alone, the export to adjoining territories amounts, it is estimated, to some 7,000 tons a year.

Several species or varieties* of *Cola* are recognised, and there seems some doubt as to whether the true Kola-nut is furnished by *C. acuminata*, *C. nitida*, or *C. vera*. The first named, however, is generally accepted as the correct source. Some trees produce a few or all white seeds, which are the most highly valued for chewing and command the highest price locally. Where both white and red "nuts" are produced on the same tree, the proportion of the former is said to increase as the tree grows older. Trees raised from white nuts do not always come true. Thus a plot of 68 trees raised from white "nuts" at Aburi gave 15,339 *white* and 3,189 *red* nuts, *i.e.* 82·8% white; 9 trees gave *white* nuts only, or 13% pure. Normally the seed consists of 2 stout cotyledons, which separate on drying, forming the so-called "nuts." In some cases each cotyledon is divided, forming "quarter nuts," which fetch a lower price. The cotyledons of *C. Ballayi* are said to be each divided into 4 or 6 parts, thus forming still smaller "nuts."

Cultivation and yield. The tree is suited to low elevations and up to 2,000 ft., requires deep and well-drained soil, a moderate rainfall, and only light shade, if any, after the trees are well established. Planting distances may be about 25–30 ft. each way. It is propagated by seed, which must be sown perfectly fresh, and begins to bear fruit when 5 or 6 years old. It should be in full bearing when about 12 years old, producing in Ceylon two crops a year, in June–July and Dec.–January. The yield is variable, 500–600 pods per mature tree being considered a fair average crop, but some trees yield much more. Each pod contains from 6 to 12 seeds (nuts), and 40–50 of these go to a pound.

Kola-nut Tree (*Cola acuminata*).
(1) Flowers; (2) unripe fruit; (3) ripe fruit showing nuts (seeds).

In the Gold Coast, practically the whole trade consists in supplying fresh "nuts" to adjoining states, the price ranging from 3*d*. to 1*s*. per 100 for full-sized "nuts," according to freshness and distance travelled. For export, they are merely dried in the sun or shade, then put into strong bags. In 1890, kola-nuts were worth 2*s*. 9*d*. per lb. in London; at the present time they fetch about 2½*d*.–3*d*. per lb. The export of kola-nuts from Ceylon in 1922 was 68 cwt., valued at about £86.

Other Masticatories.—Among the best known of these are *Coca* (see *Drugs*) and *Cutch* (see *Dyes and Tans*).

POISONOUS PLANTS

Certain families of plants are generally characterised by distinct poisonous characters, while others, as the *Cruciferae* (to which belong the cabbage, cauliflower, etc.) are remarkably free from poisonous traces. To the former belong the orders *Aroideae*, *Euphorbiaceae*, *Apocynaceae*, *Loganiaceae*, *Asclepiadeae*, *Urticaceae*, *Solanaceae*, *Umbelliferae*, and others. Some of these, however, as the last two, also furnish wholesome food products, as potatoes and carrots. Any plant which possesses a milky juice should be treated with caution until more is known about it.

Poisonous plants differ in degree of harmfulness, and the poisonous properties are sometimes affected by local conditions of soil and climate, and even by cultivation.

* Mathieus, in *Gardens' Bulletin*, Straits Settlements, Nov. 1918; Rutter, at Tropical Congress London, 1921; and Administration Report, Director of Agriculture, Gold Coast, 1920.

They may also vary according to season. Certain parts of a plant may be highly poisonous, while others are innocuous, *e.g.* Nux-vomica, which has very poisonous seeds, but the fruit appears to be harmless. The poisonous properties may consist in stinging hairs, *i.e.* hollow siliceous hairs containing formic or other acid (e.g. *Laportea*); minute sacs containing spicules of calcium oxalate (*e.g.* many *Aroideae*); a heavy acrid oil in leaves, bark, etc. (as *Semecarpus* and other *Anacardiaceae*); or alkaloids contained in the seed or cell-sap, *e.g.* Upas-tree and species of Strychnos, as used in making arrow- or dart-poison. Poisonous properties are attributed to various species of the leguminous family, e.g. *Indigofera, Lupinus, Crotalaria, Laburnum, Tephrosia*, etc., many of which are considered dangerous to stock. Certain vegetables are poisonous in the raw state, but harmless when cooked, *e.g.* Cassava (*q.v.*). Certain bean seeds of the leguminous family, especially those with pink or brown shell, are considered poisonous until cooked. The following are some well-known poisonous plants.

Abrus precatorius. Olinda-wel; Indian Liquorice. A slender, perennial climber, the bright red and black seeds of which furnish an acrid poison, and are often used criminally in India for killing cattle by arrows. The seeds are powdered and formed into a paste, with which the darts or arrows are dressed. An arrow-wound is thus generally fatal within 24 hrs. The poisonous property is believed to be in the red covering of the seed. Boiling renders the seed harmless.

Alyxia zeylanica. Wal-kaduru or Wasa-kaduru, *S.* (*Apocynaceae.*) A sh. found in the drier parts of Ceylon; the milky juice is poisonous.

Cerbera Odollam. Gon-kaduru, *S.* Small tree with acrid, milky juice and white, scented fls., common in low-country of Ceylon, chiefly near the sea. The seeds are an irritant poison.

Datura fastuosa. Thorn-apple; Attana, *S.* Small sh., with large lvs. and white or purple, trumpet-shaped fls.; fruit round, covered with numerous prickles; very poisonous. Several other spp., all poisonous. See *Ceylon Med. Plants.*

Datura suaveolens. Trumpet-flower; Rata-attana, *S* (*q.v.*). The round, green, prickly fruits are a well-known poison.

Derris elliptica. Tuba (Malaya). Large climber of India and Malaya. Bark and fls. commonly used as fish-poison, and juice as arrow-poison. Roots, pounded in water, used in Malaya against termites, crickets, etc. Cultivated in Malaya for insecticidal purposes. **D. uliginosa** (Kala-wel of Ceylon) has been found to have similar properties. Derris root is quoted in London at about 1*s.* per lb. See *Insecticides.*

Dieffenbachia, many species and varieties. Dumb-cane. Herbaceous, branchless, succulent plants, bearing a crown of large variegated lvs., commonly cultivated for ornament. The juice is highly acrid and poisonous; the slightest contact of a portion of it with the tongue will cause paralysis of the latter, making speech difficult for several days. See *Fol. Pot Plants.*

Euphorbia Antiquorum. Daluk, *S.* See *Cacti or Succulent Plants.* The acrid milky juice is poisonous, causing blindness on coming in contact with the eyes. **E. tortilis.** Sinuk, *S.* A small leafless tree; milky juice acrid and poisonous.

Girardinia heterophylla. Elephant- or Nilgiri-Nettle; Gas-kahambiliya, *S.* (*Urticaceae.*) A tall herb, covered with stinging, poisonous hairs; found in forests of montane zone.

Gloriosa superba. Niyangala or Ventonti, *S* (*q.v.*). The large fleshy tubers are poisonous and sometimes eaten by the poorer classes in mistake for edible yams, often with fatal results. The tubers, however, are said to possess important med. properties, and are occasionally enquired for from Europe.

Hura crepitans. Sandbox Tree. A large upright tree of Trop. America and W. Indies, with thorny stem and brittle wood, characterised by acrid poisonous milky juice, which may cause blindness on coming in contact with the eyes. Introduced to Ceylon in 1848. See *Curious Fruits.*

Hydnocarpus venenata. Makulu, *S.* (*Bixaceae.*) A medium-sized tree with smooth bark, common in low-country of Ceylon; fruits poisonous, used for poisoning fish.

Hyoscyamus niger. Henbane. See *Drugs.* Lvs. and seed narcotic and poisonous.

Isotoma longiflora. (*Campanulaceae.*) A small herb. annual, 1–2 ft. high, with white fls. Native of the W. Indies, introduced and naturalised in Ceylon, being now a common roadside weed. It has an acrid, poisonous, milky juice, and has been considered to be the cause of deaths amongst ponies on the Delft Island, north of Ceylon.

Laportea crenulata. Fever-, or Devil-nettle; Maussa, *S.* (*Urticaceae.*) A sh. with large oval lvs. Whole plant clothed with small, irritant hairs, which sting severely, the distressing effects often remaining for days.

Lobelia nicotianaefolia. Wild Tobacco; Rasni, *S.* (*Campanulaceae.*) A tall herb, perennial, 6–10 ft. high, with large oblong lvs., found in open ground at 4,000–6,000 ft. Lvs. and seeds are acrid and poisonous.

Manihot spp. Cassava; Mandiokka. See *Veg. and Food Crops.*

Mirabilis Jalapa. Marvel-of-Peru; Four o'clock Flower; Sendrikka, *S.* (*Nyctagineae.*) Annual, 2 ft. high, with white or pink fls., commonly cultivated for ornament. Roots and seeds poisonous. At one time erroneously supposed to be the source of the Jalap of commerce.

Modecca palmata. Hondala or Potu-hondala, *S.* (*Passifloraceae.*) Small perennial climber with large, palmate, shiny lvs., common in moist low-country; the round, scarlet fruit, of the size of a small orange, is poisonous and has often been known to cause death to persons eating it in ignorance.

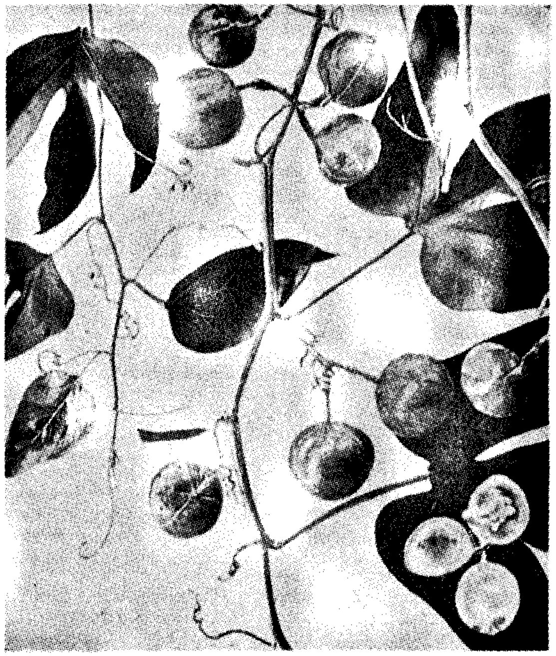
Nerium Oleander. Oleander; Arali or Araliya, *S* and *T* (*q.v.*). Milky juice and roots poisonous; used in remedies for skin diseases.

Ochrosia borbonica. Mudu-kaduru, *S.* Small tree with greenish-white fls., common near sea-coast; the bright red fruit is poisonous.

Plumbago zeylanica. Ela-nitul, *S.* A small sh. with white fls. and long succulent roots, which are acrid and poisonous and sometimes used for illegal purposes.

Polygala venenata. (*Polygalaceae.*) An erect, slender herb of Java; reputed to be intensely poisonous.

Rhus venenata and other spp. Poison Sumach (*q.v.*). Tall shrubs of China, Japan, etc., possessing a very poisonous juice. See *Lacquer Tree.*



Modecca palmata, "Hondala," *S.* Attractive-looking poisonous fruit.

Sapium indicum. Kiri-makulu, *S.* (*Euphorbiaceae.*) Small tree with smooth, white bark and narrow willow-like lvs.; acrid milky juice very poisonous.

Solanum verbascifolium. Hekarilla, *S.* Large sh. with a dense yellowish-grey tomentum; moist region up to 6,000 ft. Fruit poisonous.

Streblus asper. Geta-netul, *S*; Pirasu, *T.* (*Urticaceae.*) Large sh. or small tree, with small, scabrous lvs., common in low-country of Ceylon. The yellow fruit is edible, but the bark is an irritant poison. Lvs. used for sandpaper.

Yucca gloriosa. Adam's Needle. (*Liliaceae.*) Semi-woody, branchless plant, 6–8 ft. high, with long, rigid, sharply pointed lvs.; roots poisonous.

ORDEAL AND ARROW POISONS

Ordeal Poisons. In former times, and even till this day in certain countries, persons suspected of witchcraft or crime were made to swallow a potion of certain

poisonous plants, or confess the alleged offence; if they died from the effects they were considered to be guilty, while if they vomited the poison they were held to be innocent. The following are well-known ordeal and other poisons.

Acokanthera spectabilis. (*Apocynaceae.*) African arrow-poison. A large sh. with white, scented fls. The milky juice of the roots and shoots used by natives in W. Trop. Africa for poisoning their arrows.

Antiaris toxicaria. Upas Tree; Riti, *S.* (*Urticaceae.*) The celebrated ordeal-poison tree of Java, at one time supposed to give off poisonous fumes fatal to animal life. The sap of the bark contains a virulent poison known as "Ipoh," which is effectively used for poisoning darts or arrows. See *Fibres*.

Cerbera Tanghin. (*Apocynaceae.*) Tanghin Poison. A small tree with a milky juice, whose fruits are the famous ordeal-poison of Madagascar.

Curare. A famous poison obtained in S. America from several species of *Strychnos* (Loganiaceae.) It was formerly used as a remedy for hydrophobia and tetanus, and by the natives as arrow-poison. See *Strychnos*.

Dioscorea doemona. A climber belonging to the Yam family (*Dioscoreaceae*). The juice of the tuber, obtained by boiling, is said to be used with that of the Upas-tree (*Antiaris*) in Java for arrow-poison.

Erythrophleum guineense. Sassy Bark. (*Leguminosae.*) A well-known poisonous tree of Sierra Leone; introduced to Ceylon in 1888. The very poisonous bark was formerly used in ordeal trials and for poisoning arrows.

Excaecaria Agallocha. Agallocha; Blinding-tree; Tala-kiriya, *S.* (*Euphorbiaceae.*) A small tree with milky, acrid juice, which blisters the skin. The tree is held in fear by the natives of Fiji, where the juice is used as a cure for leprosy. Common on the coast of Ceylon and other Eastern tropical countries.

Hippomane Mancinella. Manchineal Tree. (*Euphorbiaceae.*) A well-known poisonous swamp-tree, common near the coast in Trop. S. America and some W. Indian islands. The acrid, milky juice is poisonous, and has earned for the tree a reputation almost as notorious as that of the Upas-tree of Java, it being stated that "even grass will not live under it."

Physostigma venenosum. Calabar Bean. (*Leguminosae.*) A large twining climber, whose large, ovoid, dark-brown seeds are the famous ordeal-beans of Old Calabar. The tree is now comparatively rare, its destruction having been ordered by Government.

Strophanthus hispidus and other species. Ripe seeds contain an active poison (strophanthine), long used for poisoning arrows in Trop. Africa.

Strychnos spp. The poisonous seeds of several species are used in Africa for making ordeal decoctions, also in Malaya for arrow-poisons. The root-bark of **S. Tieute** of Java yields a virulent poison called Tjettik or Upas-radja. **S. Nux-vomica** yields the powerful poison strychnine, **S. toxifera** and others the famous Curare- or Wourali-poison of Trop. America, obtained from the bark by maceration in water. See *Curare*.

Tabernaemontana malaccensis. Prachek. A large sh. with white fls. and orange-red fruits. The milky juice is used in the preparation of arrow-poison in Malaya.

CHAPTER XXVII

OILS AND VEGETABLE FATS

(1) *FIXED OILS.* (2) *ESSENTIAL OR VOLATILE OILS.*

VEGETABLE oils are of two distinct kinds, viz. *fixed oils*, as coconut, gingelly, and castor oils, which do not evaporate on exposure to the air, and *volatile* or *essential oils, e.g.* citronella, cinnamon, and clove oils, which readily volatilise on exposure. The former are obtained by crushing and pressure or by boiling, sometimes by chemical solvents; while the latter are extracted usually by distillation and generally possess the characteristic aroma of the plants from which they are derived. The former include "drying oils" (which dry fairly rapidly, leaving an elastic film), "non-drying" or "semi-drying" oils, and vegetable fats. Some fixed oils which are liquid in a warm temperature become solid in cold, *e.g.* coconut-oil; others are naturally fatty bodies, resembling grease or butter, *e.g.* those obtained from *Bassia*, *Butyrospermum*, *Pentadesma*, etc. The following are some of the principal fixed oils.

FIXED OILS

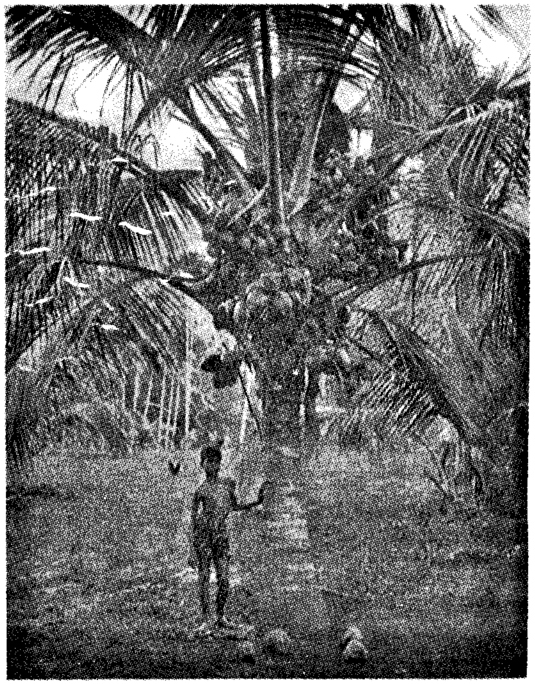
Castor-oil; Palma Christi; Endaru-tel, *S*; Amanaku-maram, *T*. (*Ricinus communis.* Euphorbiaceae.)—A tall, quick-growing perennial woody shrub or small tree, with large handsome palmate-peltate leaves, naturalised in Ceylon, often occurring as a weed in abandoned ground in the low-country and up to about 4,000 ft. It is cultivated in all warm countries, more particularly in India, Asia Minor, S. Europe, and S. United States, generally as an annual but sometimes as a perennial crop; often planted for ornament, sometimes for shade, as in arid or desert regions (see p. 205). It is suited to a wide range of climate and soil.

Cultivation. The plant thrives in ordinary land, even in brackish or saline ground, but does best in rich loamy or alluvial soil. Excessive moisture is unfavourable to the crop, but a moderate rainfall in its early growth is desirable. About 10 lb. of seed is sufficient to sow an acre, allowing 3 or 4 seeds to each hole, the latter being spaced about 6 × 6 ft.; the seedlings should afterwards be thinned out, leaving one to each hole. The seeds germinate in 8–10 days. The plants should be topped at a height of about 3 ft. They begin to bear in about 4 months from sowing, and the harvest may be completed about 3 months later. Castor is usually grown in India as a mixed crop, and in S. Persia and Iraq as a shade tree.

Yield. Planted as a pure crop, the yield under favourable conditions may be 20–25 bushels of seed ("beans") per acre; as a mixed crop 10–12 bushels is a fair average crop (about 40 lb. = a bushel). A single tree may give as much as 6–10 lb. In the United States as much as 30 bushels or 1,400 lb. per acre is sometimes obtained. The well-known oil has been used from time immemorial as a purgative, being known to the Greeks and the Romans 500 B.C. It is obtained from the seeds by pressure. Besides its use in a refined state in medicine, it is largely employed as a body for lubricating oils, also for dressing leather, in soap manufacture, etc. The residue (castor cake or poonac) after the expression of the oil

is a valuable manure, but is unfit for cattle-food; it is largely used for crops in the tropics. The seeds as well as the poonac contain an alkaloid poison (*ricin*), which, however, does not pass into the oil. The leaves furnish the principal food of the silk-worm (*q.v.*). Castor seed is now quoted at about £10–£12 per ton.

Varieties. These vary in habit of growth, size and markings of seed, etc. The large-seeded varieties yield a smaller percentage of oil, which is of inferior quality and is used mainly for lubricating and lighting purposes; while those with the smaller seeds contain a larger proportion (38–40% against 25–30%) and finer quality of oil, which is preferred for medicinal purposes. *R. zanzibarensis* is noted for its large seed. Medicinal oil is now quoted at about £36 per ton.



YOUNG COCONUT PALM IN GOOD CROP.

Coconut Palm. Pol, *S*; Tennai or Thenga, *T*. (*Cocos nucifera.*)—A tall stately palm, 70–80 ft. high, with a stout wavy stem, surmounted by a crown of long arching, handsome, pinnate leaves. It is the most important of palms, furnishing the inhabitants of the tropics with practically every requisite, including food, sugar, drink, medicine, palm-wine or toddy and alcoholic spirit, fibre, timber, thatch, domestic utensils, etc.,—in fact as many uses as there are days in the year. Though cultivated in most tropical countries, in some extensively, it is nowhere found in a wild state. Its cultivation and the preparation of its different products for local use or for export forms an important industry in Ceylon, Travancore, Philippines, Malay, Pacific Islands, etc. In Ceylon it is estimated there are well over a million acres under the product, and in the Philippines over $1\frac{1}{4}$ millions.

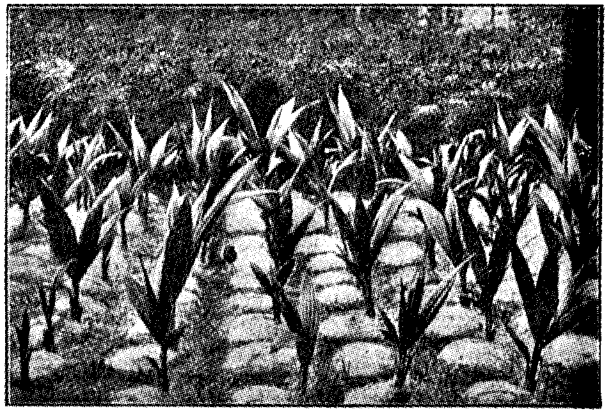
The kernel (*endocarp*) yields a valuable fatty oil, locally used in cooking, lighting, etc., and largely exported for use in soap-making, margarine, lubricants, etc. In the fresh state the kernels are shredded and made into *desiccated coconut*, largely exported for use in confectionery. The husk (*pericarp*) when retted for about 3 weeks in water yields *coir-fibre*, which is made into mats, brushes, matting, etc., or into coarse string and ropes, which are exported for use as binder twine, etc. Some 21 million whole nuts are exported from Ceylon annually.

Copra of commerce, the source of coconut oil, consists of the dried kernels. It is prepared by breaking the nut in two; the two cup-shaped halves, being easily separated from the shell, are then dried in the sun or in specially constructed low houses or kilns, over smoke and heat from smouldering fires made with the husks and shells. Forced hot-air driers are sometimes used for the purpose, the copra shells being placed in movable trays. Ceylon copra contains about 65% of oil and

ranks with the finest quality. Some 6,500 tons copra were exported in 1933, valued at about £8 per ton, in addition to large quantities of the oil. From 1,000 to 1,300 nuts, according to size and thickness of kernel, go to a Ceylon candy of copra, and 4 candies = 1 ton. In Malaya, Philippines, etc., copra is sold by the picul ($133\frac{1}{3}$ lb.). 250–330 nuts go to a picul, and 16 piculs = 1 ton. Ceylon oil is now quoted at about £22 per ton, against £55 in 1925. *Poonac* (residue after expression of oil from the copra) is a valuable cattle-food and fertiliser.

Toddy and Arrack. The sweet juice extracted from the spadix by incision and "tapping," when fresh and unfermented is known as *toddy* and forms a pleasant, sweet beverage; fermented and then distilled, it yields *arrack*, a strong alcoholic spirit. (See *Palm Sugar.*) For toddy-drawing, the best and healthiest trees are selected. Tapping may continue for 6 or 8 months in the year, according to climate, and the yield may be 40 gall. or more per tree in that period. Each inflorescence may be tapped daily for 2 or 3 months. From $6\frac{1}{2}$ to 7 gall. toddy produce about 1 gall. arrack of 25 degrees under proof. Fresh arrack is sold retail at about Rs. 8 to Rs. 10 per gallon. Arrack improves with age; old spirit fetches the highest price. The extraction of toddy means of course the sacrifice of the nut-crop.

Cultivation. The palm requires a hot and moist climate, deep alluvial or loamy soil, thriving especially near the seaboard, but also to a considerable distance inland provided climatic conditions and soil are suitable. Rocky, laterite, or stagnant soil are unsuitable. In Ceylon it thrives up to about 2,000 ft. It is propagated by the large, ovoid (bluntly 3-angled in husk) nuts, which are sown in the husk in nursery beds, being laid on their sides and almost covered with soil. These germinate in about 3 months, and in 10 months the seedlings, with nut attached, are ready for planting out. Or the nuts may be planted *in situ* in well-prepared holes. The holes should be not less than 3 ft. deep by 3 ft. wide, and should remain open for some time previous to planting. After planting, they should at first be only partially filled with good surface soil, to which may be added some well-decomposed manure. In course of time the holes become filled through the process of cultivation and weathering, and the plants are thus ensured protection when young and a firm hold of the ground when grown up. Planting distances depend on soil and locality; 30 × 30 ft. is sometimes adopted, but 28 × 28 ft. (55 to the acre), or even closer in less favourable conditions, is more common.

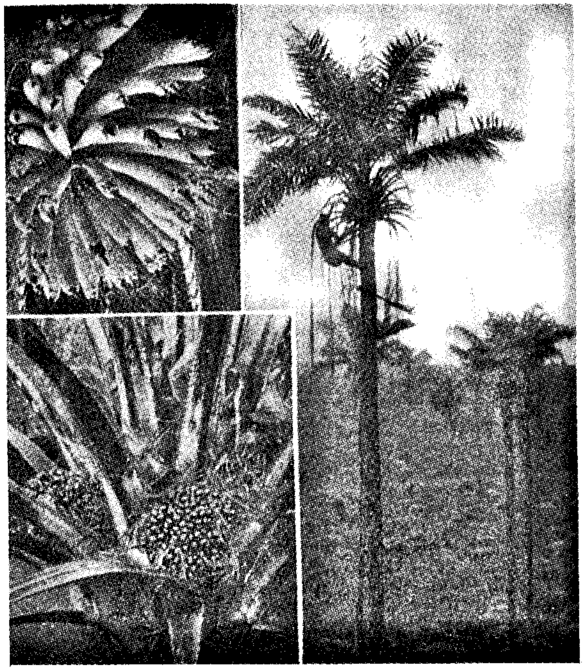


SEEDLING COCONUTS IN NURSERY.
Showing nuts laid on their sides.

Yield, etc. A small crop may be obtained when the palms are 7–8 years old; but they may not be in full bearing till about the age of 15 years. They continue to yield profitable crops until about 50 years old, fruiting all the year round. The crop per tree may vary from 40 to 80 nuts a year, and an average of 3,000 nuts to the acre is considered a satisfactory yield, though it may be as much as 4,000 or more. With good cultivation, under favourable conditions, 4,000 nuts should give 1 ton copra, besides 6 cwt. coir-fibre. It is usual to make six rounds of plucking a year, *i.e.* once in two months. Heavy clusters of nuts should be supported by means of a forked stick, with a pointed end, placed against the stem at the base of the leaves, as shown to the left in the illustration. The palms attain a height of 60–80 ft., with an unbranched, wavy stem. They are readily climbed by coolies, who throw their feet in a loop of cloth, rope, or fibre, pressed against the

stem and are thus afforded a foothold. In Ceylon and S. India the ripe nuts are picked by hand, but in some countries they are allowed to fall to the ground as they ripen, and are then gathered. See *Charcoal*.

Varieties. Numerous varieties occur in cultivation, these varying in size, shape, yield, thickness of husk and copra, height of tree, etc. Some of the more distinct varieties are known by different local names. King Coconut (Tambili, *S*) is a distinct variety, said to have originated in Ceylon, bearing a yellow, ovoid fruit, distinguished by its sweet juice and esteemed for culinary purposes, but it is of little commercial value for copra. The "Dwarf Coconut" ("Nyiur-gading" of Malaya) bears fruit when about 4–5 years old and when the stem is only 2 or 3 ft. high, the nuts being small but numerous. Of these, an average crop of 100 nuts per tree may be expected when the palms are 8 years old, so that with 90 trees to the acre (24 × 20 ft.) a yield of 9,000 nuts per acre may be obtained. 500 "dwarf" nuts may go to a picul of copra. Some plantations of this variety have been made in Malaya. The "Needle Coconut," cultivated in the Nicobar Islands, has a long triangular fruit, the nut tapering to a sharp point at the end. The "Maldive Coconut" is characterised by a small, almost round, fruit; while the "Nawasi" or the edible-husked coconut is furnished with a husk which, when tender, is fleshy and of a sweetish-acid taste.



OIL PALM (*Elaeis guineensis*).

Showing natives' method of climbing for the nuts; also male flowers (top left), and female flowers and nut clusters below.

Oil Palm. (*Elaeis guineenis.*)—A stately, erect handsome palm, 60–70 ft. high, with a stout stem and large pinnate leaves, native of W. Trop. Africa, where it forms the principal natural product of the country. It occurs over extensive areas, either naturally or in a semi-cultivated state, more especially in S. Nigeria. The palm furnishes the natives with many of their needs; the fruit as well as the oil obtained from it enters largely into their daily food; from the tender upper portion of the stem they extract palm-toddy, which forms an intoxicating drink (see *Palm Sugar*); while with the leaf-stalks and leaves they build and thatch their houses. The palm is monoecious, *i.e.* bears both male and female flowers on the same tree but in separate bunches. The flowers are fertilised by wind or insects, but may be assisted by hand, *i.e.* by tying sprigs of male flowers above the females, as in the Date palm.

Cultivation, etc. The palm thrives in a hot, humid climate and low-lying alluvial soil. It requires similar climatic conditions to Cacao, and a somewhat lower rainfall than the Coconut palm. In Ceylon, where it was introduced in 1850, it grows luxuriantly up to about 2,000 ft., also in the N.C. Province with a rainfall of 60–70 in. Extensive areas have recently been planted under the product in the Dutch E. Indies and Malaya, from which the oil as well as kernels are exported.

Propagation and Planting. Fresh seeds may germinate in about 4 or 5 months after sowing, but often take 8 months or longer. Germination may be hastened by soaking the seeds in hot water for a few days, or by placing them between layers of stable manure so as to set up fermentation. Seedlings may be planted out about 8 months after germination or when about 2 ft. high, being spaced 28 × 28 ft. (55 palms to the acre) or, as is more usual, 26 × 26 ft. Wide spacing has the effect of developing stout and short stems, thereby facilitating harvesting of the crop besides being more productive. The palms begin to bear when 4–6 years old, and should be in full bearing at the age of 12–15. After the age of about 30 years the yield gradually declines.

GINGELLY, SESAME, OR SIM-SIM (*Sesamum indicum*).

Showing capsules containing numerous small seeds, rich in oil.

The outer covering (pericarp) of the fruit yields "palm-," "pulp-," or "pericarp-oil." This is largely used in W. Africa for cooking and to some extent for lighting, being obtained by boiling and pounding. It is largely exported for use as a lubricant and in the manufacture of soap, etc. Distinct from this is the "kernel-" or "white-oil," obtained by machinery or solvents, which is the more valuable and is largely used for margarine and cooking-fats. The residual cake is a valuable stock feed and is usually worth about £8 per ton.

Yield. The average annual yield of fruit per mature tree in an uncultivated state is variously estimated at from 60 to 80 lb. or more, but cultivated palms may give double these figures. Rutgers * estimates as follows for Sumatra plantations: 5th–10th year, average 53 lb. of nuts per tree; 11th–30th year, 165 lb.; 31st–50th year, 66 lb. Each mature palm produces from 5 to 10 bunches a year, each weighing from 20 to 40 lb. or more according to age. An acre of mature trees is considered to yield 4 tons of fruit, or ½ to ¾ tons of kernels. In 1925, before the general slump in values, Palm kernels were quoted in London at about £20 per ton, Kernel oil at £45, and Palm oil at £38–£40.

Varieties. Numerous varieties or sub-varieties are recognised, these varying in yield as well as in quality, size and colour of fruit, which may be green, red, black, or dark purple, with thick or thin shell. Many are given local names, as Abe-pa, Opa-pankoro, Ope-arunfo, Osok-eyop, Potshi, Qua-qua, etc. The "Deli" type has a good reputation in Sumatra. The variety "King Palm" is held sacred in W. Africa and yields "Holy Oil." "Soft oil," valued chiefly for cooking, is obtained by fermenting, pounding and boiling the pericarps.

Gingelly-oil; Sesame, Til, Sim-sim, Bene, Beni-seed, Mafuta, Tala-tel, *S.* (*Sesamum indicum.* Pedaliaceae.)—An erect annual, 2–4 ft. high, indigenous to Ceylon, S. India, Trop. Africa, etc., commonly cultivated in the tropics and sub-tropics for the small seed, which is largely exported for its oil, of which it yields by expression about 45–50%. The latter is largely used for cooking, lighting, medicine

* *Investigation on Oil Palms* by Dr. A. A. L. Rutgers, Sumatra (1922). *Bull. Imp. Inst.*, Vol. VIII, No. 4 (1909); *Bull. Dept. of Agric., Ceylon*, 1922.

and various domestic purposes; also for salad oil, margarine, soap-making, etc. There are several varieties, the seeds of which there are black, yellow, red, and white, the latter yielding the finest oil and is preferred for cooking.

Cultivation. The plant is grown as a summer crop in warm or subtropical countries, as in S. Italy, S. United States, Iraq, etc., and thrives in light friable soil with moderate rainfall. After the land is well tilled the seed is sown broadcast, or in drills about 1½ ft. apart, at the rate of 8–10 lb. per acre. The crop is ripe in about 4 months, and is then cut, tied in bundles and stooked. If allowed to become fully ripe the pods will burst and disperse the seed. In India the usual yield is about 400–600 lb. per acre, producing about 10 gall. oil. The residue (Gingelly-cake) is a valuable cattle-food. The seed is quoted in London at about £20 per ton. Some 4 million acres are estimated to be under the crop in India alone.

Cotton-seed Oil (see *Fibres*).—One of the most important sources of commercial oils is cotton seed after it has been separated from the fibre. The best seed yields 20% or more of oil, which is largely used in the manufacture of soap, paint, etc., and refined qualities in salad oils. The supply of cotton seed is an important part of the industry in cotton-growing countries. The seed is now quoted in London at about £6, and the oil at £25, per ton.

Ground-nut Oil (see *Trop. Veg. and Food Crops*).—One of the most important of commercial oils, obtained by pressure from Groundnuts, which are extensively exported from India, Africa (East and West), Sudan, Java, etc., both in the decorticated and undecorticated state, the former coming chiefly from Coromandel, China and Java, and commands the highest price. Nuts now quoted at about £15 per ton and the oil at £25 to £30.

Linseed Oil. (*Linum usitatissimum.*) See *Fibres*.—This valuable and well-known oil, obtained from the seed, is extensively used in paints, varnishes, linoleum manufacture, printers' ink, etc. The plant is largely grown in India for the seed only, yielding at the rate of about 350–400 lb. per acre. Seed is quoted at about £12 per ton, and the oil at £22. Linseed-cake, obtained after expression of the oil, is a valuable cattle-food and worth about £6 per ton.

Olive Oil (see *Olive*). Considered the best of all salad or culinary oils. It is obtained by pressure from full-grown but unripe fruit, and very largely used for domestic purposes and medicine. Seeds quoted about £12 per ton. See *Olives*.

Sunflower Oil. (*Helianthus annuus.* Compositae.)—A tall, quick-growing coarse annual, 5–8 ft. high or more, native of Mexico, etc., extensively cultivated in parts of India, China, S. America and elsewhere for the seed, which yields a valuable edible oil. The plant thrives in ordinarily good soil with a warm and moderately moist climate. Different varieties are commonly grown, for ornament or utility, in all warm countries, thriving in the tropics at medium and high elevations. The seed may be sown in rows 3 ft. apart, about 8–10 lb. being required to sow an acre. The seedlings are afterwards thinned out to about 12 or 15 in. apart. The ground should be well tilled and manured.

Yield. A crop is obtained in about 4 months after sowing, yielding 30–40 bushels of seed per acre, which should give nearly a gallon of oil per bushel, or about 30%. The method of harvesting is similar to that of Maize, the heads being gathered, dried, and then threshed; or the seeds are rubbed out by hand over a coarse grater. Sunflower seed for oil extraction is usually worth about £17 per ton. The oil, which is obtained by pressure, is edible and of a pleasant flavour. The seed, roasted or boiled, is sometimes used as an article of food, and forms a nutritious food for cattle and poultry. The residue after the extraction of oil makes a good cattle-food.

Shea Butter. "Butter-tree" or "Emi." (*Butyrospermum Parkii.* Sapotaceae.)—A medium-sized or large tree with a stout trunk, bearing rather leathery, oval leaves about 6–9 in. long by 3–4 in. broad, crowded at the ends of the branches, native of W. Trop. Africa. The large fleshy nuts (seeds), of which each fruit usually contains only one, yields a large percentage of stearine fat, which is used by the natives for cooking. It is exported to some extent, chiefly from N. Nigeria, and has been used in the preparation of cheap chocolates, also in the manufacture of soap and candles. The fat has been valued in London at about £20 per ton. The tree is a slow grower, and was introduced to Ceylon in 1893.

Soya-bean Oil (see *Trop. Veg. and Food Crops*).—A very important oil, both for culinary and industrial purposes, obtained by pressure from the seeds (beans), which are largely exported from Manchuria. They contain about 18% of oil, and are now quoted in London at about £8 per ton, the "crude oil" being £16 to £18.

Tung- or **Wood-Oil.** (*Aleurites Fordii.* Euphorbiaceae.)—A small tree of China, suited to high elevations or subtropical conditions with moderate rainfall. The kernels yield a valuable "drying" oil, largely used in the paint, varnish and linoleum trades, with an increasing demand; also locally for lighting, lacquer-work, etc. The oil-cake residue, being poisonous, is only fit for manuring. Other species which are valuable sources of oil are: *A. cordata* (Japanese Wood-oil) and *A. montana*, both natives of S. China and requiring similar conditions to the above. *A. moluccana* (= *A. triloba*) is a native of Malaya and Pacific Islands and is widely distributed in the tropics, being naturalised in India, Ceylon, Madagascar, W. Indies, etc. It is familiar as Candle-nut Tree, Country Walnut, Eboc, Kukui (Hawaii), Bankul (French Colonies), Tel-kekuna (Ceylon), and is suited to tropical conditions up to 3,000 ft. The nuts are rich in oil and sometimes strung together and used as candles. *A. trisperma*, known as Balucanat in the Philippines, is similarly rich in oil. An average Tung tree may produce 100–150 lb. of nuts a year, yielding about 35–40% of oil. The seeds may take about 2 to 3 months to germinate. The first named has recently been planted on a commercial scale in certain subtropical climates. It is said to give 5 tons seed (1,800 lb. oil) per acre of 60 mature trees.

Vegetable- or **Chinese-Tallow.** A product of *Stillingia* (*Sapium*) *sebifera* (Euphorbiaceae), a small tree, about 30 ft. high, native of China and Japan. The fatty oil obtained from the layer surrounding the seed is used in China in place of animal tallow for the manufacture of candles and soap, also in cloth dressings, etc. The kernels yield a yellowish oil used by the Chinese in the preparation of varnishes and for lighting, etc., and a mixture of the oil and fat is stated to form a good substitute for lard for industrial purposes. Vegetable-tallow is exported from China in hard white lumps, weighing about ¼ cwt. each. The tree was introduced to Ceylon before 1824 and has become naturalised in the vicinity of some up-country gardens, where it seeds abundantly. Birds are fond of the fruit, which probably accounts for the local distribution of the tree.

OTHER FIXED OILS

Amoora Rohituka. Hingul, *S.* (*Meliaceae.*)—Moderate-sized tree of Ceylon, India, etc. Oil from seed used for lighting, etc.

Argania Sideroxylon. Argan-oil. (*Sapotaceae.*)—Medium-sized tree of Morocco, where it is largely cultivated. Seeds yield an oil used in cooking and said to be almost equal to olive oil. Leaves and fruit are a valuable food for stock in N. Africa.

Attalea Cohune. Cohune-nut. (*Palmae.*)—Kernels, the size of a hen's egg, yield an oil similar to coconut-oil and suitable for use in margarine manufacture. Charcoal made from the fruits was largely used for gas masks in the late war.

Azadirachta indica. Margosa (Portuguese); Nim- or Neem-tree of India; Kohomba, *S*; Vempu, *T*. (*Meliaceae.*)—A tall tree of India, Ceylon, etc. The strong-smelling, aromatic oil obtained from the fruit is much valued in native medicine, being a well-known application for rheumatism, etc., and is taken internally by women in pregnancy. It is commonly used for animals, both internally and externally. A most valuable tree to the peasants, all parts being used for medicine or domestic purposes. (See pp. 196, 209.)

Balanites Manghamii. Manduro. (*Simarubaceae.*)—A tree of Portuguese E. Africa. The nuts yield a clear oil, burning with a bright flame, much used locally. **B. aegyptiaca.** "Desert Dates." A tree found in drier parts of W. and Cent. Africa. Fruit edible and yields a clear oil called Betu- or Zachun Oil.

Bassia butyracea. Indian Butter-tree. (*Sapotaceae.*)—A medium-sized deciduous tree of Cent. India, occurring at 1,000–5,000 ft. The seeds yield by expression a thick oil or fat used locally for burning and externally for rheumatism, etc.; also used as an adulterant in "ghi." Flowers not generally eaten, but a syrup prepared from them yields a spirit or is made into sugar. **B. latifolia.** Mahua or Mahwa; Mowra. A large, spreading tree with broad leaves, common in Cent. India up to 4,000 ft., often cultivated and of importance locally. From the seeds is obtained a thick, yellow oil or fat known as "mowra fat," commonly used in India for cooking, etc. The seed was largely exported before the war, chiefly to Germany, the oil being used in margarine, soap and chocolates. Mowra-cake is not suitable for cattle food, but makes a good fertiliser. (See *Edible Flowers.*) **B. longifolia.** Mi or Mee, *S*; Ilippi or Illupai, *T*. A large tree of Ceylon, Malaya and S. India. Often cultivated for the fleshy seeds, which yield an oil esteemed locally for cooking, also used in medicine, etc. The cake, after the expression of the oil, is known as "arippu,"

and is exported from Ceylon to S. India as a fertiliser. The tree is deciduous for a short period in the dry season. From the fleshy edible flowers is obtained a spirit.

Brassica juncea. Aba, *S*; Kaduga, *T*; Indian Mustard or Rai. (*Crucifereae.*)—An erect annual, of which there are several varieties, 2–4 ft. high, naturalised in Ceylon, etc., commonly cultivated in N. India and elsewhere, usually as a catch-crop, the small seeds yielding an oil used in cooking, medicine, etc. Seed is sown broad-cast in well-tilled soil at the rate of about 6–8 lb. per acre, which yields from 250–300 lb. of seed. (See *Veg. and Food Crops.*)

Calophyllum Inophyllum. Punnai-nuts; Domba, *S*; Dommakottai, *T.*—Medium-sized or large, handsome tree of Ceylon, India, etc. The nuts yield abundant dark green, thick and strongly scented oil, employed locally in medicine and for burning. They are collected in Ceylon as a "forest produce," under licence. Some 2,000 cwt. nuts are usually exported annually from Ceylon, mainly to India, valued at about 10*s*. per cwt. **C. tomentosum.** Keena, *S*; Pongu, *T*. A tall tree with straight trunk and quadrangular twigs, native of the moist low-country of Ceylon, W. India and Malaya. Seeds yield an orange-coloured oil (Keena-tel), used for medicine, lighting and other domestic purposes. This is the Kina or Keena Tree of the lower hill-country which is not so striking as the larger Keena (*C. Walkeri*) of higher elevations. (See *Keena.*)

Carapa-, Crapa- or **Crab-oil.** *Carapa guianensis.*—The large fruit contains numerous seeds which yield an oil used in Guiana, etc., for medicine, lighting and other purposes. (See *Orn. Fol. Trees*, also *Timbers.*)

Carthamus tinctorius. Safflower Oil. (See *Dyes.*)—Largely cultivated in India, Egypt, Caucasus, etc., for the seeds, which yield safflower-oil by pressure. The oil is used in India for culinary purposes, also in the manufacture of paint and soap and for dressing leather. A dye is obtained from the flowers.

Diospyros Embryopteris. Tunka Oil. Timbiri. Used medicinally in India.

Dipterocarpus glandulosus. Dorana-tel, *S*. (*Dipterocarpeae.*)—A tall, erect tree of Ceylon. A resin which exudes naturally from the stem and is collected at the base, yields an oil used in medicine, etc.

Dumoria Heckeli. Bako-nuts. (*Sapotaceae.*)—The large, ovoid, smooth seeds, with a large oval scar along one side, are obtained from a large tree, 100 to 150 ft. high, of W. Trop. Africa and are rich in oil, edible and valued for soap-making.

Garcinia echinocarpa. Madol-tel, *S*.—Small tree of Ceylon. Seeds yield an oil used in medicine.

Guizotia abyssinica. Ramtil-, Inga-, Black-til- or Niger seed-oil. (*Compositae.*)—An annual, largely cultivated in India and Africa for the oil obtained from the seed; used locally for cooking, lighting, and medicine, and exported for use in margarine, etc. Seed commonly used as food for cage birds. Yield, 300–400 lb. per acre.

Gynocardia odorata. (*Bixaceae.*)—Large tree of Sikkim, etc. Bears large globular fruits, the seeds of which yield a drying oil of good quality, known as Gynocardia-oil. This was formerly supposed to be the source of Chaulmugra oil.

Hemp-seed Oil. Obtained by pressure from the seed of *Cannabis sativa* or Indian Hemp. It is of a greenish-yellow colour and used chiefly in paints and varnishes; produced largely in China, Formosa, Algeria, etc. Hemp seed is quoted at about 20*s*. per cwt. It is also used for bird-food. (See *Fibres*, also *Drugs.*)

Hydnocarpus anthelminticus and **H. wightiana.** "Kavatel." (*Bixaceae.*)—Medium-sized trees of India, Burma, etc. An oil similar to Chaulmugra oil is obtained from the seed and used as a cure for leprosy. (See *Taraktogenos.*)

"Illipe." Edible fat- or oil-yielding seeds of *Bassia* (in India), *Shorea* (in Java), *Isoptera* (in Borneo, etc.).

Irvingia Olivera. Cay-cay or Dika. (*Simarubaceae.*)—A slow-growing, straggling tree of Indo-China, the kernels of which are edible and rich in fatty matter.

Jatropha Curcas. Physic-nut; Pulsa- or Parqueira-oil; Rata-endaru, *S*; Kaddamanakku, *T.*—A well-known shrub, commonly planted as a fence round peasants' gardens, being readily propagated from large cuttings (see *Hedges*). Cultivated in Portuguese W Africa. A strong purgative oil obtained from the seed is used in native medicine and exported to Portugal for use in soap and candle manufacture. Residual cake poisonous.

Kokoona zeylanica. Kokun-oil; Potha-eta-tel, *S*. (*Celastraceae.*)—Large tree of Ceylon and S. India. Seeds yield oil used for lighting and medicine.

Lophira alata. Scrubby Oak. (*Dipterocarpeae.*)—A small ornamental tree, native of Sierra Leone; yields an edible fat known as Kiam- or Meme-butter.

Moringa pterygosperma (*q.v.*). The seeds yield a fine oil known as Oil-of-Ben, used by watchmakers and in cosmetics.

Pentadesma butyracea. Tallow- or Butter-tree; Okoto- or Koma-nut Oil. (*Guttiferae.*)—A large tree with long, straight, regularly radiating branches, native of W. Trop. Africa. The large, oblong fruit (5–6 in. long by 3½ in. diam.) and large fleshy seeds (3–4 in each fruit) contain a quantity of yellow, waxy juice, which is used by the natives for the extraction of an edible oil. The oily seeds were valued in England in 1925 at £8 per ton. An average tree bears 700–900 fruits or about 150 lb. of seed a year. Introduced to Ceylon 1897, and bears a heavy crop of fruit each year, during April–May.

Poppy-seed Oil. Derived from the seed of *Papaver somniferum* (*q.v.*), used in artists' paints, etc., and exported chiefly to France. Average yield of seed per acre, about 4 cwt.

Quillai Bark or **Soap-bark Oil.** (*Quillaria saponaria.* Rosaceae.)—Small tree of Chile with saponine bark, readily raising a lather in water; used locally as Vegetable soap, also exported and now quoted at about 34*s*. per cwt.

Tallow- or Butter-Tree (*Pentadesma butyracea*). A, Fruit in section.

Sapindus emarginatus. Penela, *S*; Neyk-kodan, *T*; Soap-nut. (*Sapindaceae.*)—A large tree of Ceylon (dry region), India, Burma, etc. Fruits, dry or fresh, are saponine in water and used as a substitute for soap. **S. Saponaria.** Soap-berry. Small tree of Jamaica. Fruit strongly saponaceous.

Schleichera trijuga. Ceylon Oak; Kusumb of India. (*Sapindaceae.*)—A large tree of Ceylon, India, Burma, etc. Seeds edible and rich in oil, said to be the original Macassar oil. (See *Lac.*)

Taraktogenos Kurzi. Kalaw or Kalaw-ni. (*Bixaceae.*) — A large or medium-sized tree of Burma, Siam, etc. The large fleshy seeds yield a thick yellowish oil or fat of the consistency of butter, valued in the treatment of leprosy and other skin diseases. This is the true Chaulmugra-oil, formerly supposed to be obtained from *Gynocardia odorata* (*q.v.*). The tree was introduced at Peradeniya, Ceylon, in 1922. Cultivated in Hawaii. (See also *Hydnocarpus.*)

Trichilia emetica. Malfura or Mafureira-nut. (*Meliaceae.*)—A handsome E. African deciduous tree, yields 60–80 lb. dry nuts per tree. Nuts rich in fatty oil, edible and used in the manufacture of soaps and candles. The residue as well as the seed is considered poisonous.

ESSENTIAL OR VOLATILE OILS

Obtained Usually by Distillation.

Ajowan Oil. (*Carum copticum.* Umbelliferae.) (See *Thymol.*)

Anise Oil, Star. (*Illicium anisatum.*) (See *Spices.*)

Backhousia citriodora. (*Myrtaceae.*)—A small tree of Queensland and N. Australia. Leaves yield a valuable essential oil, used in medicine and perfumery.

Basil Oil. (*Ocimum Basilicum.*) Sacred-, or Sweet Basil; Basilique; Tulsi (India); Suvanda-tala, *S*.—A strongly scented herb, yielding from the leaves an essential oil used in scented soaps, perfumes, etc.; grown commercially in Reunion and Morocco; also commonly cultivated in India. (See *Sacred Plants.*)

Bay Oil. (*Pimenta acris.*)—Oil distilled from the leaves in certain W. Indian islands is quoted at about 6*s*. per lb. (See *Spices.*)

Bergamot Oil. (*Citrus Bergamia.*)—Oil obtained from rind of fruit valued at about 12*s.* per lb.

Cajeput Oil. Australian Tea Tree; Gelam (Malaya); Loth-sumbul, *S.* (*Melaleuca Leucadendron*, var. *minor.* Myrtaceae.)—A tall tree of Malaya, N. Australia, etc. A volatile oil obtained from bark and leaves is valued in medicine as a stimulant and tonic, etc. and valued at 15*s.* to 20*s.* per lb. The annually shed flaky bark is much valued by Sinhalese native doctors; also in Malaya for torches, etc.

Calamus Oil. Sweet Flag; Jeringu (Malaya); Wadakaha, *S.* (*Acorus Calamus.*)—A herbaceous perennial with large radical leaves, widely distributed in temperate and tropical countries; naturalised in Ceylon, commonly found in swampy ground at low elevations. Rhizomes used in native medicine, being collected under a royalty fee of Re. 1 per cwt. An aromatic oil distilled from them is used for flavouring liqueurs, also in medicine. (See *Insecticides.*)

Camphor Oil. (*Cinnamomum Camphora.*)—Distilled from the wood or leaves and obtained from Formosa and Japan. It is quoted in England at about 95*s.* per cwt. (See *Camphor.*)

Cananga Oil, or **Ylang-ylang.** (*Cananga odorata.*) See *Perfumes.*

Caraway Oil. (*Carum carvi.*) See *Condiments.*

Cassia Oil. (*Cinnamomum Cassia.*) See *Spices.* The clear, greenish-yellow oil, obtained from leaves and young twigs in S. China, is "intensely sweet, with cinnamon-like odour, and strongly refractive." It is quoted in England at about 4*s.* per lb., and used for scenting soaps, etc. Like cinnamon, the bark also yields a valuable oil.

Chenopodium or **Worm-seed Oil.** (*Chenopodium ambrosoides*, = *C. anthelminticum.* Chenopodiaceae.)—A perennial herb, 2–3 ft. high, introduced and now common in the montane zone of Ceylon. A strongly scented and aromatic oil obtained from the seed and leaves is valued as a vermifuge, especially in hookworm treatment, being priced at about 38*s.*–40*s.* per lb. "Quinoa Seed" (*C. Quinoa*) is edible and used in favourite dishes in Chile, etc. (See p. 299.)

Cinnamon Oil. (See *Spices.*) **Citronella Oil.** (See *Citronella.*)

Clove Oil. (*Eugenia caryophyllata.*)—The strongly aromatic oil obtained from cloves is antiseptic and valued in medicine, etc., being quoted about 4*s.* per lb.

Coriander Oil. Usually quoted at about 2*s.* per lb. (See *Condiments.*)

Cumin Oil. (See *Condiments*, etc.)

Eucalyptus Oil. (*Eucalyptus globulus* and other spp.)—Blue Gum. The leaves yield a strong pungent essential oil, valued in medicine as an antiseptic, febrifuge, etc.; now quoted about 1*s.* per lb. Oil of *E. citriodora* (Lemon-scented Gum) usually fetches a higher price and is used in perfumery.

Geranium Oil. (See *Perfumes.*) **Ginger-grass Oil.** (See *Cymbopogon Martini.*)

Lemon-grass Oil. (See *Cymbopogon citratus.*)

Lemon Oil. (*Citrus Limonum.*)—See *Fruits.* Sicilian hand-pressed from fruit rind, quoted about 3*s.* 6*d.* per lb.

Lignaloe- or **Lin-a-loa Oil,** Mexican. Distilled from the wood of fairly old trees of *Bursera delpechiana* and other species, and used in perfumery. "Guayana Linaloe Oil" is derived from *Ocotea caudata* (Lauraceae), a hard-wooded tree of S. America; the wood is exported from Cayenne, being cut in logs and deprived of bark.

Lime Oil. (*Citrus Limonum* var. *acida.*)—See *Fruits.* The oil, obtained from unripe fruits by expression, is quoted at about 4*s.* per lb., distilled oil being 29*s.* The chief source is the W. Indies, especially Dominica and Montserrat.

Neroli Oil. Distilled from the fresh blossoms of the Orange and valued at from 6*s.* to 10*s.* per lb.; used in perfumery, etc.

Palmarosa Oil. (See *Cymbopogon Martini.*)

Patchouli Oil. Patcha or Patchapat (India); Cablan (Malaya). (*Pogostemon Cablin.* Labiatae.)—A herbaceous shrub, 3–4 ft. high, native of Philippines, cultivated in Malaya, Java, Bourbon, India, etc., for the sake of the oil obtained from the leaves and young shoots, which is used in perfumes and scented soaps. Propagation is by cuttings, and the plants are spaced about 3 × 3 ft.; these are ready for plucking in about 6 months from planting, and twice or three times a year afterwards. The collected material is dried in the sun preparatory to the extraction of the oil by distillation. The yield of oil should be at the rate of about 2 lb. for a picul (133⅓ lb.) of dried leaves, of which 1,500 lb. per acre a year may be obtained. The plant thrives in a hot humid climate, with a good rainfall and moderately rich soil. Replanting is necessary after 3 or 4 years. Seed is seldom produced. *P. Heyneanus* (Kollankola of Ceylon) also yields an essential oil similar to the above, and is sometimes cultivated in India and Java. The oil is quoted at about 15*s.* per lb., the best grade usually coming from Malaya. Patchouli leaves also are exported. (See *Perfumes.*)

Peppermint- or **Spearmint-Oil.** See *Peppermint*, p. 361.

Petitgrain Oil. (*Citrus Bigaradia*, or Bitter Orange.)—The oil is distilled from the leaves, twigs and immature fruit, the best quality coming from Paraguay and is valued at from about 4*s.* per lb. (See *Orange.*)

Sandal-wood Oil. Handum, *S.* (*Santalum album.* Santalaceae.)—A small tree, 30–40 ft. high, with small leaves, native of Mysore, etc. The fragrant reddish heartwood yields about 5–7% of valuable aromatic oil, used in perfumery, ritualistic ceremonies, etc., and quoted at about 20*s.* per lb. The tree is of a semi-parasitic habit and slow growth, requiring from 20 to 40 years to develop a full amount of heartwood. The latter is usually worth from £60 or more per ton. The oil is present in all parts of the tree, varying in proportions and quality, the roots giving 6%, leaves and shoots 4%, bark 2%. Heartwood is odourless when fresh, but has a strong aromatic odour when dry. Suited to rather dry, rocky situation, which produces the best oil. Introduced to Ceylon in 1869, now semi-naturalised around Badulla, about 2,000 ft., where the rainfall is limited chiefly to 3 or 4 months of the year, viz. in the north-east monsoon.

Oil-grasses. These include a family of tropical grasses rich in aromatic, volatile oil, formerly known mostly under the generic name of *Andropogon*, but now included in the genus *Cymbopogon*. Their botany has long been confused, many of the species of some authors being regarded by others as varieties or forms. The vegetative characters do not, in many cases, show very sharp distinction. The following are the best known:

Camel Grass. (*C. Schoenanthus.*) Khavi (India).—Native of N. Africa, N. India, etc., thriving in dry, arid localities, and distinct by the large swollen culms formed by the leaf-bases. Yields an aromatic oil mostly used for medicinal purposes.

Citronella Oil. (*Cymbopogon Nardus.*) Citronella Grass; Pengiri-mana, *S.*—A large coarse grass, 4–5 ft. high, cultivated in Ceylon and Java for the essential oil obtained from the leaves by distillation. The grass grows on ordinary soil in a hot and moist climate, up to about 2,000 ft., but its commercial cultivation is confined to the sea-coast. It is estimated there are some 30,000 acres under the product in Ceylon. The grass is readily propagated by root division (fertile seed being rarely produced), and planted about 2 × 3 ft. in rows. Permanent shade is unnecessary and cultivation is simple, weeding and occasional manuring being the chief requirements. The leaves are ready for cutting about 8 months from planting, and thereafter every 4 months, subject to weather, each cutting averaging about 12 tons per acre. 40–50 lb. of oil per acre is considered a good average annual yield. Replanting is necessary once in 4 or 5 years.

The oil has a strong aromatic odour, and is exported for use in perfumery, scented soaps, etc. Mixed with other ingredients, as coconut-oil, kerosine, etc., it is an excellent preventive against mosquito and leech bites. The present market value of the oil is about 2*s.* per lb., Java grades usually fetching the highest price. Like many other oils, citronella is sometimes adulterated, generally with kerosene oil, and this fact depresses the price. The export of the oil from Ceylon in 1933 was nearly 1½ million pounds, valued at £95,537.

Varieties. In Ceylon two distinct varieties occur, viz. Maha-pangiri or Winter's Grass, and Heen- or Lenabatu-pangiri. The former is distinguished by a more robust habit, with long and broad leaves, and though rich in oil it is said to require more frequent replanting than Lenabatu; the latter, therefore, being considered hardier, is often preferred for planting. A robust variety with long, broad, drooping leaves, introduced from Java, is known at Peradeniya as "Java Maha-pangiri."

Lemon-grass Oil. (*Cymbopogon citratus.*) Lemon- or Melissa-grass; Sereh (Malaya); Saira, *S*; Vasana-pillu, *T.*—Resembles Citronella-grass in general appearance, but is distinct by the odour of the leaves and less robust habit of growth; gives a smaller yield of oil, which, however, commands a higher price than Citronella oil. Its propagation and cultivation are similar to those of Citronella. The grass is unknown in a wild state. It is cultivated in Ceylon to a small extent, but the chief source of supply of the oil is S. India. Cochin Lemon-grass Oil is now quoted in

London at about 4*s.* per lb. The oil is used for flavouring, and in scented soaps, perfumery, medicine, etc.

Malabar- or Cochin-grass Oil. (*C. flexuosus.*) Kodi-pillu, *T.*—A tall grass, bearing large, loose, greyish panicles; yields an oil known as Malabar- or Cochin-grass oil. Stapf considers this to be a superior form of Lemon-grass oil.

Palmarosa- or Nimara Oil. (*C. Martini.*) Palmarosa-, Rusa-, Geranium-, Ginger-grass, etc.—A rather slender grass of Cent. and N. India, bearing panicles of a distinct reddish-brown tint. Yields an oil from the lvs. and fls. similar to that of *C. citratus*, known by the above names and valued at about 5*s.*–6*s.* per lb. The grass occurs in two vars., *Motia* or Palmarosa, and *Sofia* or Rusa, etc. The oil from the former commands the highest price.

C. Jawarancusa, Stapf.—Similar to *C. Schoenanthus*, but distinct from it by the long, broad, flat leaves. It is said to prefer moist localities, as near rivers or streams, while the latter species is naturally found in dry, arid localities.

C. coloratus, similar to *C. flexuosus*, but is less robust and has narrower lvs.

C. polyneuros (= *Andropogon Schoenanthus*, var. *versicolor*, Trimen).—A robust, spreading grass, indigenous to Nilgiris and Ceylon up-country patanas; common on the Island of Delft, Ceylon, and known as the Delft-grass or Kapuru-pillu, *T.* (= Camphor-grass). The odour of the leaves, however, on being crushed more resembles that of fennel or anise than camphor.

C. confertiflorus. Maana Grass; Toda of the Nilgiris.—An erect, coarse grass with long blades, 5 ft. or more in height, common on the patanas of Ceylon and S. India. The leaves, on being crushed, emit a strong, overpowering odour. Cattle will not eat it, except in a young state after the patanas have been burned. Commonly used as thatch.

Andropogon odoratus. Leaves in dense bunches, yield an inferior kind of oil. The name Ginger-grass is also applied to this species.

Vetiver Oil. (*Vetiveria zizanoides*, Stapf, = *Andropogon muricatus* or *A. squarrosus.*) Khas-khas or Khus-khus of India; Vetiver-grass; Saivandera, *S.*—A distinct, upright grass with narrow, odourless leaves, but with strongly scented roots. The latter have an aromatic odour like that of sandalwood, and yield by distillation an oil known as Vetiver-oil. Tied up in small bundles or bags, they are often used for placing in wardrobes, etc., for the sake of their fragrance and for the purpose of keeping away insects. They are also woven into fancy mats, fans, etc. In India the grass is much used for "tats" for shading verandahs, these being kept moist during hot weather by sprinkling with water, after which they emit a fragrant odour. Under cultivation it is estimated that one ton of roots per acre, in 2 crops, may be obtained in a year, each crop yielding about 6–7 lb. of oil, or 14 lb. per ton of roots. Reunion Vetiver-oil is usually quoted at about 25*s.* or more per lb. in London. It is much used in perfume compounds, etc.

CHAPTER XXVIII

RUBBER, GUTTA, GUMS, RESINS, ETC.

(1) *HEVEA & OTHER CULTIVATED RUBBERS.*
(2) *OTHER SOURCES OF RUBBER.*
(3) *GUTTA & BALATA.*
(4) *GUMS, WAXES, & RESINS.*
(5) *INCENSE WOODS, ETC.*
(6) *CAMPHOR.*
(7) *LAC OR SHELLAC.*

HEVEA

RUBBER may be obtained from certain laticiferous trees, climbers, or shrubs, being extracted in the form of white milk (*latex*) by means of incisions (*tapping*) made in the live bark (*cortex*). Until recent years rubber was a forest product obtained chiefly from wild trees in Brazil. About 1895 it began to be taken up as a plantation crop in the Eastern tropics, and now most of the world's supply comes from plantations of *Hevea brasiliensis*, known as Para Rubber, only a comparatively small proportion coming from uncultivated *Hevea* trees in the forests of Brazil.

The product of the latter is known in the trade as "Hard Para" or "Wild Rubber," of which some 20,000 tons are collected and exported annually. It comes on the market in large round or ovoid lumps or rolls, weighing about 80 to 100 lb. each. These have usually a hole through the centre, caused by the pole on which the mass is formed, this being revolved by hand over smoke while the latex is being ladled over it (see *Coagulation*). The pole is withdrawn when the rubber is dry, thus leaving a hole. African Wild Rubber, obtained from stems of large climbers (chiefly spp. of *Landolphia*) and from roots of tuberous plants, was until recently largely exported, usually in the form of round black balls, called "Negroheads." "Native Rubber" denotes peasant cultivation of Hevea in Java, etc.

Hevea is a quick-growing, tall, erect tree, of the family *Euphorbiaceae*, native of Brazil, introduced into tropical Asia in 1876, through the Royal Botanic Gardens of Kew, and now extensively cultivated. Plants were first established at, and later propagated and distributed by, the Botanic Gardens of Ceylon, Singapore and Java. About the year 1898 the cultivation received a great impetus owing to a large demand for rubber, caused chiefly by the sudden development of the motor industry, and it has since made rapid strides in Ceylon, Malaya, Sumatra, Java, Burma, S. India, etc. The area under rubber cultivation in Ceylon rose from a few hundred acres in 1900, to over ½ million acres in 1930; that in British Malaya is now over 1¼ million, while the area for the British Empire is estimated at about 2 million acres. The first official restriction on the export of rubber from Ceylon and Malaya, begun in 1922, was abolished in Nov. 1928, after which the price level of rubber dropped to the uneconomic figure of about 2*d.* per lb. Consequently rubber plantations were either worked at a considerable loss or temporarily abandoned. A new scheme of international restriction was

introduced in 1934, followed at once by a marked improvement in the market value of the product.

Cultivation. The *Hevea* tree thrives in any moderately good, deep soil, provided the rainfall is not under 80 in. a year and is fairly evenly distributed, with a minimum temperature of about 70° F. In Ceylon, it flourishes from sea-level to about 2,500 ft. Propagation is usually by seed. Sowing at stake is best if efficient protection from vermin is provided; otherwise planting with "stumps" or basket-plants is advisable. Vegetative propagation by means of bud-grafting (see *Patch Budding*) of selected clones has been advocated, and considerable areas have been planted up in recent years in various parts of the Eastern tropics with trees so raised. Good deep holes, about 2½ × 2½ ft., should be prepared.

Modern Rubber-tapping in Ceylon (*Hevea brasiliensis*).

Spacing in the first place may be about 20 × 20 ft., or at the rate of 100 trees to the acre, allowing for thinning out later, on the merit of individual trees, to about 60–70 trees to the acre. Too close planting results in the exclusion of light and air when the trees attain maturity, and consequently in unhealthy trees and unsatisfactory renewal of bark over the tapping area. Good cultivation and manuring encourages young trees to make good growth, coming into bearing early.

Tapping. The tree becomes tappable at the age of 5 or 6 years, or when the stem has attained a girth of about 24 in. at 2 ft. from the ground. Special "knives" on the principle of a chisel with a safety guard, or a gouge-chisel or farrier's knife, are employed for tapping. It is essential to prevent the tapping knife from penetrating the cambium, otherwise a knotted condition of the stem will result, which will not only render future tapping difficult but may also affect the life of the tree. Formerly large V-shaped cuts were made, and from these were evolved the "herring-bone," "½ herring-bone," "spiral" and "½ spiral" systems.

At the present time a single slanting cut from left to right (see illustration), beginning at about 2 ft. from the ground, is in general vogue. The circumference of the stem being divided into two equal halves, each of which is divided later into 4 sections, the first cut is made at an angle of about 22½ degrees, *i.e.* ¼ of a right angle. A thin shaving (not less than 32 to the inch) is taken off the lower side of the cut every second or third day for 10 or 11 months in the year, allowing a month or more for resting during the dry season (usually February in Ceylon), when the tree discards the old leaves and after a brief interval puts on fresh foliage. Six inches of bark is thus consumed in a year, so that in about 8 years the whole of the old bark up to the tapping height is exhausted, and the process is repeated on the new bark. On some estates a change over to the opposite side of the tree is made once in six months. While the cut surface is fresh the latex flows to the lower end, where it is conducted by means of a small spout (with a pointed end for inserting in the bark) to a small cup or the half of a coconut shell. When emptied, the cups are inverted and replaced on the hooks until required again. A coolie will tap, according to weather, etc., 200 to 250 or more trees a day (or about 8 to 10 lb. of dry rubber), beginning with daylight and finishing about 10 a.m., when the latex is collected from the cups or shells into enamelled buckets and brought to the factory. The latex is then strained through a fine brass mesh, after which it is ready for—

Coagulation.—Latex coagulates on standing, and that of some species more rapidly than others (see *Castilloa*). In the case of Plantation Hevea, coagulation is accelerated by the addition of acetic acid. The latex is first standardised, by the addition of water, to a density of 1½ lb. of rubber per gallon, this being ascertained by means of a hydrometer or "metrolac." To every 50 gallons of latex thus standardised, 4¾ oz. of acetic acid is added for complete coagulation. Heating also hastens the process, during which the rubber particles coalesce to form a white spongy mass. This is passed between machine rollers, under running water, and pressed into various commercial forms, as lace, crepe, blanket-crepe, smoked sheet, block, etc. Formerly it was commonly made into biscuits,* but this entailed too much labour when large quantities were dealt with. The rubber is then dried in hot-air dryers, or in a smoke-house provided with smoke-flues from a smouldering fire placed outside. Smoke is considered to have a preservative effect on the rubber. In the case of Wild or Hard Para rubber, smoking and coagulation are effected in one process, the latex being ladled over a round stick while the latter is revolved by hand over the smoke of palm kernels, the roll increasing in layers as fresh latex is poured on it, as already stated. Ordinarily about 2 weeks are required for the rubber to become dry and ready for export, but with hot-air dryers the process may be completed in a few days.

1 2 3 4

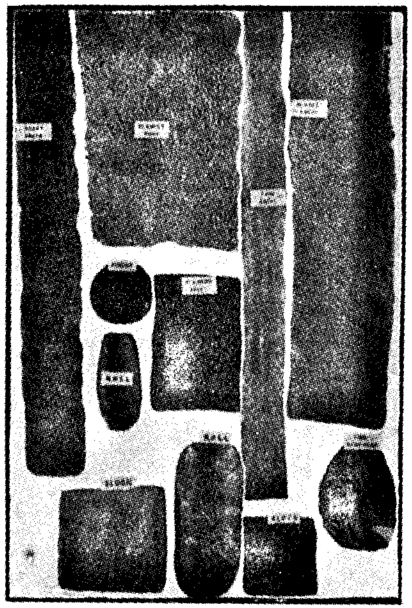
Rubber Tapping Evolution.

1, V-cuts on lower portion, herring-bone on upper with scaffolding. 2, Spiral tapping; 3, Herring-bone on lower portion only. 4, Modern system of 1-cut on half, beginning about 2 ft. from ground.

* First devised by John Parkin, M.A. (Cantab.), 1898–99.

Yield, etc. The average annual yield of dried rubber may be approximately ¾ lb. per tree at 6 years of age, increasing to 2 or 3 lb. per tree at 9 years, and to about 4–6 lb. when 12–14 years old. A return of 150 lb. dried rubber per acre per annum from trees 6–7 years old, and about 500 lb. at 10 years old is considered a good average yield, though in many cases much larger crops may be obtained if desired.* The trees increase in circumference of stem at an average rate of 3½–4 in. per annum until 12 years old, and at a slower rate thereafter.

They bear seed when about 7 years old, each tree producing from 1,000 to 2,000 seeds, increasing to about 6,000 when 18 years old. The large, oily seeds (2 or 3 in each fruit) have a thin brittle shell and yield an oil by pressure. The oil has been reported on as suitable for varnishes, etc. About 110 average seeds weigh 1 lb. They are of short vitality, and germinate in about 10–12 days when fresh. Plantation rubber latex is now exported in considerable quantities and used for certain manufactures for which rubber in this state is indispensable. It is necessary to treat such latex for transport with a preservative agent or anti-coagulant, the agent generally employed being 3% ammonia.



COMMERCIAL FORMS OF RUBBER.
Top from left: Scrap crepe, worm-crepe, lace, blanket-crepe.
Centre: Biscuit, diamond sheet, roll.
Bottom row: Block, roll, block, hard-para from Brazil.

Ceara Rubber. (*Manihot Glaziovii.* Euphorbiaceae.)—A small or medium-sized spreading, quick-growing tree, 30–40 ft. high, native of Trop. America, introduced to Ceylon in 1877. In 1883, as many as 977 acres were reported to be under this product in Ceylon, but it was afterwards neglected until the demand for rubber increased. In 1905–1912 "Ceara" became a paying proposition, being considered second in quality only to Hevea rubber. The tree is suited to a rather dry climate and medium elevations, and is tappable at the age of 4–5 years. *Manihot* latex coagulates rapidly without the addition of acid.

The tree may be propagated by seed or cuttings. The former are of a hard, horny character, retaining their vitality for a long period; they should be rasped at one or both ends before sowing, or buried for some time in a fermenting manure heap. About 720 seeds go to a pound. Those about a year old are sometimes preferred for propagation, fresh seed being considered by some to be slow and uncertain in germination. The seeds are edible when roasted, and have a nutty flavour.

Jequie Manicoba Rubber. (*Manihot dichotoma.*)—A quick-growing tree, similar to but rather smaller than the Ceara-rubber tree, being distinct from the latter by the regular forking of the branches. It is a native of S. America and was introduced to Ceylon in 1907. The seeds are larger than, but not so hard as, those of the above.

Remano Manicoba Rubber. (*Manihot piauhyensis.*)—Another S. American tree, resembling the two preceding species, reaching a height of only 8–15 ft. A native of the State of Piauhy, it was introduced to Ceylon in 1908. Other species of *Manihot* (e.g. *M. heptaphylla*, etc.) yield rubber similar to the foregoing.

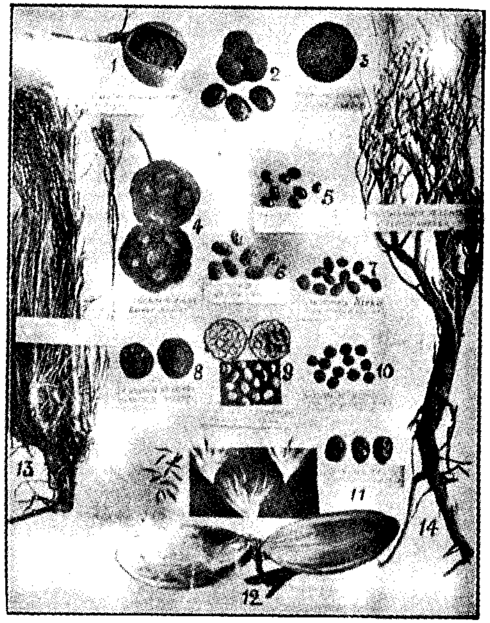
Panama- or Ule Rubber. (*Castilloa elastica.* Urticaceae.)—A tall, quick-growing tree, with large, oval, coarse leaves, native of Cent. America, introduced to Ceylon in 1876. It is propagated by the white, papery seeds, which are of the size of peas and of short vitality; thrives best at low or medium elevations, with a rainfall

* No. 2 tree at Henaratgoda Botanic Gardens, Ceylon, planted in 1876, yielded 392 lb. of dry rubber in 4 years and 9 months, in 1908–13.

of not less than about 75 in. Spacing is the same as for *Hevea.* It was at one time recommended for cultivation, but was not successful, owing chiefly to tapping difficulties.

Lagos Rubber; Ofruntum Tree. (*Funtumia* (*Kicksia*) *elastica.* Apocynaceae.)—A large, upright tree, 40–50 ft. high, native of W. Trop. Africa, Uganda, etc., introduced to Ceylon in 1899. Cultivation is much the same as for *Hevea*, but unlike the latter it does not take well to tapping. The yield is comparatively small, though the quality is good. The seeds are small, brown and grain-like, with a long silky appendage at the apex; they germinate in about 14 days. The tree has been planted to some extent in parts of Africa, but has now given place to *Hevea.*

Rambong-, Assam-, or **India-Rubber.** (*Ficus elastica.* Urticaceae.)—A very large spreading tree, with large aerial roots developed downwards from the branches, or latterly to form enormous buttresses which spread over the surface of the ground (see p. 95). The aerial roots as well as the stems may be tapped, but the tree may take 12–15 years to attain a tappable size, when it yields large quantities of rubber, which is collected as "scrap" and formed into large balls. This is the earliest source of rubber known, and was originally used for erasers. The tree rarely produces fertile seed, and has to be propagated by cuttings, which do not readily strike root, or by layering. Not now cultivated for rubber.



SPECIES OF RUBBER-YIELDING PLANTS.
1, Cryptostegia grandiflora (fruit); 2, Hevea brasiliensis (fruit and seed); 3, Raphionacme utilis (tuber); 4, Willughbeia firma (fruit); 5, Manihot Glaziovii (seeds); 7, Landolphia Kirkii (seeds); 8, Hancornia speciosa (fruit); 9, Castilloa elastica (fruit and seeds); 10, Sapium biglandulosum (seeds); 11, Manihot sp. (seeds); 12, Funtumia elastica (fruit and seed); 13, Actinella Richardsonii (whole plant); 14, Parthenium argentatum (whole plant).

Guayule- or Mexican Rubber. (*Parthenium argentatum.* Compositae.)—A low shrub, 2–4 ft. high, native of the dry arid regions of Mexico. During the rubber boom this came into prominence as a source of a low-grade rubber, for the extraction of which large quantities of the dried shrub were exported.

Ecanda- or **Bitinga-Rubber.** (*Raphionacme utilis.* Asclepiadeae.)—A low shrub with a large tuberous root, not unlike a turnip in form, native of treeless grass tracts or plateaus in Zambesi. It is found chiefly at elevations of 4,000–5,000 ft., and was considered of some importance as a source of rubber, which was obtained from the root by a process of rasping and boiling.

Jelutong. A glutinous rubber-like substance obtained from spp. of *Dyera* (chiefly *D. costulata*) and *Alstonia*,—tall, erect trees of Borneo, Sumatra, and Malaya. The trees are tapped generally once a week, in a similar manner to *Hevea.*

OTHER SOURCES OF RUBBER (UNCULTIVATED)

(These yield only a small proportion of rubber-like substance, and have now ceased to be of commercial importance.)

Actinella Richardsonii. (*Compositae.*) Colorado Rubber. Dwarf shrub of Mexico.
Bleekrodea tonkinensis. (*Urticaceae.*) Tonkin Rubber. A tree of Cochin China.
Carpodinus lanceolatus. (*Apocynaceae.*) Root-rubber. African climber, with large tuberous roots.
Clitandra henriquesiana. (*Apocynaceae.*) Root-rubber. Cent. African shrub.
Dyera costulata. (*Apocynaceae.*) Jelutong. Large erect tree of Borneo and Sumatra, found chiefly in swamp districts. Yields by tapping a glutinous substance from which about 12% rubber may be obtained by treatment with solvents.
Euphorbia rhipsaloides. (*Euphorbiaceae.*) Almeidina, or Potato-gum. A small succulent tree of Mozambique, yielding a kind of rubber which fetched 6*d.*–9*d.* per lb. in 1913.
Ficus Vogelii. (*Urticaceae.*) West African-, Congo-, or Memleku Rubber. A medium-sized tree, introduced to Ceylon in 1881.
Forsteronia floribunda. (*Apocynaceae.*) Milk-vine of Jamaica.
Hancornia speciosa. (*Apocynaceae.*) Mangabeira- or Pernambuco Rubber. Small shrubby tree of Trop. America; fruit edible, seed of short vitality.
Landolphia Kirkii. Zanzibar Rubber; **L. owariensis.** Congo Rubber. **L. ugandensis.** Nandi Rubber. A large vine found in Uganda at elevations of 4,000–5,000 ft. Rubber obtained by shaving off slices of bark, the latex being coagulated by smearing salt water on the surface.
Mascarenhasia elastica. (*Apocynaceae.*) Hazondrano, or Madagascar Rubber. A tree 40–50 ft. high, with several upright furrowed stems, slender branches and opposite lvs. Native of Madagascar, etc., introduced to Ceylon in 1902.
Sapium Jenmani. (*Euphorbiaceae.*) Large trees, yielding Carthagena Rubber of Colombia and Tonckpong Rubber of British Guiana.
Urceola elastica. (*Apocynaceae.*) A large climber of Burma.

GUTTA, BALATA, ETC.

Gutta, or **Gutta-percha.** A substance similar to rubber, obtained from a group of tall but slow-growing trees of the family *Sapotaceae*, indigenous chiefly to the Malay Archipelago. Formerly the trees were felled in order to obtain the gutta from incisions made in the bark, but are now protected or cultivated, tapping being in the form of numerous slanting cuts. An average collector will bring in about 2 lb. of crude gutta a day. Unlike Hevea, the trees cease to yield if tapped at frequent intervals, *i.e.*, it does not possess a similar wound response.

Gutta may also be extracted from the leaves by solvents, or by pounding and treating with hot water. The article is always in good demand, and is exported from Malaya and Java, where extensive plantations have been made, especially in the latter country. Gutta softens in heat, but, unlike rubber, does not deteriorate or "perish" thereby. It is cleaned in hot water and pressed into moulds to form blocks of a regular size for export. Gutta is largely used for insulating marine cables and other wires, making goloshes, soles for boots, shoes, etc., and its collection in Malaya from forest trees is under Government protection.

The following are the principal gutta-yielding trees, all of Malaya:

Palaquium (*Dichopsis*) *Gutta*, known as Taban-Gutta or Getah-Taban-Merah; *P. Maingayi* (Gutta-Tabban Simpoo); *P. pustulata* or *P. oblongifolium* (Gutta-Taban-Puteh); *P. obovata* and *P. Treubii*. *P. grandis* (Kiri-hembiliya, *S*) is indigenous to the moist low-country forests of Ceylon, but does not appear to yield gutta. *Payena Leerii*, of the same family, introduced to Ceylon in 1880 and established at Peradeniya and Henaratgoda Gardens, yields in Malaya the Gutta Sundek, while Gutta Singgarip is obtained from the climber *Willughbeia firma*, of the family *Apocynaceae*. The two first named formerly commanded from 3*s.* to 4*s.* per lb., but at present the usual price is about 10*d.*–1*s.* per lb. The export of Gutta from Singapore in 1920 amounted in value to over 8 million dollars.

Balata, a product analogous to gutta-percha, is obtained chiefly from *Mimusops globosa* (Sapotaceae), known as Bully- or Bullet-tree, a very large tree, found chiefly in Venezuela and the Guianas. The former wasteful method of obtaining the product was by felling the trees in the early morning, when large cuts were made in the bark. In the afternoon the gummy latex was collected, coagulated by boiling, the substance being then pressed into slabs or blocks and afterwards sun-dried. An average tree may yield as much as 18 lb. balata, which may now be worth about 1*s.* per lb. About 1½ million pounds has been annually exported from British Guiana alone. Balata has considerable powers of wear and resistance, and is used for belting, water-proofing, etc.

Cow Tree. (*Brosimum Galactodendron.* Moraceae.)—A large tree with unbranched trunk for upwards of 60–70 ft., native of Trop. America. Yields copious latex which closely resembles cow's milk and is said to be used by the natives for food, being considered "agreeable and wholesome." Hevea latex is said to be sometimes similarly used by Tamil coolies in Ceylon.

VEGETABLE WAX, GUMS, RESINS, ETC.

Candelilla Wax. The product of *Euphorbia antisiphyllitica*, a shrubby plant, native of the drier parts of Mexico. Wax occurs as a thin coating over all parts of the stems and branches and is separated by boiling, yielding 3–4% of almost pure wax. This is used in the manufacture of polishes, floor-waxes, varnishes, carbon papers, gramophone records, etc., and valued at about 1*s.* per lb. in London. The Candelilla plant (signifying "little candle," from the smooth, cylindrical, leafless branches) is easily propagated by cuttings. The name is also applied to *Pedilanthus Pavonis*, a shrub of the same family, 6–8 ft. high, also of Mexico.

Carnauba Wax. A product of the Brazilian Wax-palm (*Copernicia cerifera*), a handsome pinnate-leaved palm, 30–40 ft. high, found in abundance in parts of Brazil, first introduced to Ceylon in 1889. On the underside of the leaves is a thin layer of wax, which is collected by gathering the leaves and exposing them in a dry place to wither, with cloth spread underneath; as the leaves dry, the wax cracks and peels off in flakes, being afterwards collected, melted, and poured into moulds; or the wax may be scraped from the leaves with a blunt-edged knife, or by cutting the leaves into sections and boiling these in water, when the liquid wax rises to the surface and is then skimmed off. The leaves are collected three times a year in the dry season, about 10–12 leaves being obtained yearly from each palm. On an average, 2 lb. of wax may be obtained from 100 leaves.

The collection of the wax is an important industry in Brazil, where the annual export of the article amounts to some 2,000 tons, valued at about 45*s.* per cwt. The wax is used for the manufacture of fine-quality candles, polishes, gramophone records, etc. The value of the wax is dependent upon tint, texture, and richness in oil. It is melted down and afterwards graded into three qualities; the best being of uniform pale-cream tint and rich in oil; inferior grades are darker and less rich in oil. It is used locally for lighting. The small black seeds are edible.

Wax-palm of Colombia. (*Ceroxylon andicola.*)—This differs from the Carnauba wax-palm, in that the wax is deposited on the trunk and not on the leaves, while the palm itself is suited to a higher elevation and cooler climate. It is obtained in a similar manner to the above.

A specimen flourished in a sheltered spot in Hakgala Gardens, Ceylon (elevation

5,500 ft.), where it was introduced about 1890, for about 25 years, reaching a height of over 30 ft., when the monsoon winds proved to be too much for it. The palm normally grows to a height of about 30–40 ft., and the trunk is usually distended half-way up. The wax, which is deposited between the leaf-scars on the trunk, often so thick than it can be removed in flakes, is used in the manufacture of candles, etc., and forms an article of trade in Colombia. The annual yield of wax per tree is said to be sometimes as much as 20 lb. or more.

Ivory-nut Palm or **Corozo-nut**; Tagua Palm. (*Phytelephas macrocarpa.*)—A slow-growing, dioecious palm, with handsome pinnate, erect leaves, 15–20 ft. long, native of Colombia. Introduced to Ceylon in 1850, it has flowered and fruited in Peradeniya Gardens at irregular intervals during the last 40 years. For many years stemless, the palm forms in course of time a short prostrate stem. The large white seeds, contained in large, round clusters of spiky fruits produced at the base of the palm, become very hard as they ripen, and furnish what is known as Vegetable-ivory. They are used for making superior buttons, articles of ornaments, etc., and command about 40*s.* per cwt. The chief source of supply is Ecuador, whence some 20,000 tons are said to be exported annually. Other palm seeds which are or were to some extent used as vegetable-ivory are *Raphia* spp. (*q.v.*), *Attalea Cohune* (Coquilla- or Cahoon-nuts), etc. See fig. on p. 157.

Chickle Gum is obtained from *Achras Sapota* (see Sapodilla under *Trop. Fruits*). Commonly cultivated in the tropics for its delicious fruit, it is also largely employed in S. Mexico and Cent. America for the extraction of the gum, which is obtained in the form of latex. V-shaped or slanting incisions are made in the bark, these being arranged so that the latex flows in a stream to the base, where it is collected in leaves or other simple receptacles. The latex, after being strained, is coagulated by heating, after which the gum is kneaded and pressed in the desired forms.

Chickle-gum forms the basis of chewing-gum, so largely used in America, being scented and flavoured with mint, vanilla and other ingredients. Good-yielding trees are said to produce from 3 to 5 lb. of gum annually, in some cases much more. The production of the gum is an important industry in parts of the countries named, over 2,000 tons being exported annually from Mexico, chiefly to the United States. Considerable quantities are also exported from British Honduras.

Gamboge of commerce comes mainly from Siam, being produced chiefly by *Garcinia Hanburyi*, a slow-growing, moderate-sized tree of the Mangosteen family. The trees, when at the age of about 12 years, are tapped during the rainy season, a spiral groove being cut half round the trunk. The yellowish viscous fluid trickles along the cut, and is collected into small hollow bamboos placed below. It is then strained into smaller bamboos, and left for a month to solidify. The bamboo is afterwards separated from the gamboge by heating over a fire, when it cracks and is easily removed. "Roll" or "pipe" gamboge, which is the usual commercial form, is thus obtained.

Indian Gamboge, which is generally in the form of "tears" or "grains," is obtained from *Garcinia Morella*, a small tree found in E. Bengal, W. India and Malaya. The tree is also common in the low-country of Ceylon, where, however, gamboge is now but little collected. The method of obtaining gamboge in Ceylon is usually by cutting gashes in the bark, the gummy latex being allowed to coagulate in the cuts and then stripped off. Trimen reported in 1883 that a consignment of Ceylon gamboge, in the natural "tears," fetched £14 5*s.* per cwt. in London. Gamboge is used in artists' paints, also in dyes and medicine. The quotation in London for Siam gamboge now ranges from £12 and £15 per cwt., according to quality and demand.

Benzoin; Gum Benjamin. (*Styrax Benzoin.* Styraceae.)—A moderate-sized tree, native of Malaya, chiefly Sumatra and Java, yielding a fragrant gum-resin which is soluble in water and known by the above names. It is a forest product, obtained by incisions made in the bark, often done in a crude manner by means of a hatchet. A few days later a yellowish latex begins to exude, and this is allowed to continue for a period of 3

months. Being then sufficiently hardened, it is collected, generally with fragments of bark adhering, and is then cleaned and graded.

The yield from subsequent tappings improves in quantity and quality. July–September is the usual period of collection, though it can be carried on practically all the year round. The yield is variously estimated, though the average is probably about 3 lb. per tree per annum. Several grades or forms of the article are recognised, as "Siam," "Sumatra," "Palembang," etc. The first is sometimes quoted at £27 or more per cwt. in London, while the other grades usually command from £6 to £7 10*s.* per cwt. Benzoin occurs in commerce in two forms, "Block" and "Tears." Its chief use is for burning as incense in churches, but it is also used in medicine and perfumery. The tree thrives at Peradeniya, Ceylon, where it was introduced in 1881, producing seed usually in September–October. *Styrax officinale*, a small tree of Asia Minor and S. Europe, yields a gum-resin known as True Storax, for which there is little demand.

OTHER SOURCES OF GUMS, RESINS, ETC.

Acacia senegalensis. Gum-arabic; Hashab (Sudan). A small tree of Sudan, Senegal, etc., and the principal source of commercial gum-arabic, which exudes naturally from stem and branches; the exudation is assisted by making incisions in the bark. **A. arabica.** Babul. A small tree of Trop. Africa, India, Ceylon, etc., yields the Indian gum-arabic. Mature trees produce up to about 2 lb. of gum each a year. **A. decurrens** and other species (evergreen trees of Australia) yield Wattle-gum, valued at about 30*s.* or more per cwt., according to demand.

Agathis alba. A large coniferous tree of Malaya, yielding the gum known as Dammar or Dammar-minyak, obtained from incisions in the bark. Singapore Damar has been valued in England at from £3 per cwt., according to quality and demand. **A. australis.** New Zealand Kauri. Large, handsome tree; yields Kauri-copal, a valuable gum-resin, some 15,000 tons of which are collected annually in the tree's native home for the extraction of oil and turpentine.

Anogeissus latifolia. Dhaura. (*Combretaceae.*) Medium-sized tree, supposed to be the source of the Ghati-gum of India.

Aquilaria Agallocha. Eagle Wood; Aloes Wood. (*Thymelaeaceae.*) Moderate-sized tree of Assam, Burma, etc. Yields a dark, fragrant resin, used for incense and known as Kayu-garu by the Malays, and Akyau by the Burmese. From this is obtained by distillation an oil used in perfumery and medicine.

Astragalus gummifer. (*Leguminosae.*) Gum Tragacanth. A small, thorny shrub of Persia, Syria, etc. The gum exudes from incisions or wounds in the bark and is of commercial value, being used in medicine and manufactures.

Bursera spp. (*Burseraceae.*) Lignaloe or Lin-a-loa. A genus of small, shrubby, slow-growing, aromatic trees with bipinnate lvs., natives of Mexico. They yield by exudation from the stem a fragrant balsam-resin, used in incense. The wood from old stems is exported in small pieces for the extraction by distillation of an oil used in perfumery, medicine, etc. The most important species are *B. cuneata*, *B. delpechiana* and *B. gummifera*. The last named, also known as Turpentine-tree, yields a balsam-resin known as American Elemi, Cachibou, or Gomart. **B. tomentosa,** of Venezuela, yields Tacamasha Resin, used in medicine, incense, etc.

Canarium strictum. (*Burseraceae.*) Black Dammar; Gugul of India. Large, handsome tree of India. Valuable resin, used in medicine, is obtained by incising and firing base of tree. *C. bengalense*, a similar tree, introduced to Ceylon in 1881; yields copious fragrant resin. *C. zeylanicum.* Mala Kekuna, *S.* Large tree of low-country, Ceylon. Fragrant gum-resin exudes copiously from base of trunk.

Copaifera Lansdorfii and **C. officinalis.** (*Leguminosae.*) Balsam of Copaiba. Large trees of Brazil; yield a balsam or gum-resin from base of trunk, used in varnishes, etc. Quoted at 1*s.* 4*d.* per lb.

Doona zeylanica. Dun, *S.* Tall, handsome tree of moist low-country of Ceylon. Fragrant gum-resin exudes from base of trunk of this and other species.

Dryobalanops aromatica. (*Dipterocarpeae.*) Borneo- or Sumatra-Camphor; Kapur Barus. A tall tree; yields a camphor-like resin, exported to China, Japan, etc., for use in medicine, varnishes and embalming. Valued about 20*s.* per cwt. **D. grandiflorus**; "Apitong" of Philippines. Yields an oleo-resin, also valuable commercial timber known as Bagac.

Guaiacum officinale. Lignum Vitae; Gum Guaicum. (*Zygophylleae.*) Small, very slow-growing tree of Trop. America. A green resin exudes naturally from stem, or is obtained from incisions in the latter, or by cutting the tree into sections and driving the resin out by fire-heat. Quoted at 1*s.* 9*d.* per lb.

Hymenaea verrucosa. Copal Resin. Large, spreading tree of Madagascar. Resin obtained from bark incisions, or dug from ground (natural exudations) at base of tree; largely used in varnishes. **H. Courbaril.** Locust Tree of W. Indies and Trop. America. Medium-sized or large tree; yields a resin known as Gum-animi.

Japanese Wax. (See *Rhus succedana* below.)

Liquidambar orientalis. (*Hamamelideae.*) Liquid Storax. Tree of Asia Minor, 30–40 feet high; wood yields by distillation a fragrant balsam-resin.

Melanorrhoea usitatissima. (*Anacardiaceae.*) Varnish Tree. Burma. Large tree with broad, oval leaves; resinous juice obtained from stem is at present quoted at about 5*s.* 6*d.* per lb., Balsam of Tolu (*M. Toluifera*) being 1*s.* 10*d.* per lb.

Myroxylon Pereirae. Balsam-of-Peru. Large, spreading tree of Trop. America; aromatic gum-resin, obtained from base of tree, now valued at 5*s.* per lb.

Odina Woodier. (*Anacardiaceae.*) Hik, *S.* Small tree of Ceylon, India, Java, etc. Gum obtained from stem.

Pistacia Terebinthus. (*Anacardiaceae.*) Chian-turpentine Tree. Small tree of Asia Minor, Mediterranean, etc. An oleo-resin obtained from incisions in bark. **P. Lentiscus.** Mastic. Small tree of N. Africa, Asia Minor, etc. Resin obtained from incisions in bark is used in chewing-gums, dentistry, etc.

Pterocarpus marsupium. (*Leguminosae.*) Gammalu, *S*; Kino. Ceylon and S. India. A tree 50–60 ft. high; gum-resin exudes naturally from trunk.

Raphia Ruffia. Raffia Palm of Madagascar. After removal of fibre a considerable quantity of valuable wax is obtained by beating the dried leaves on mats. (See *Fibres.*)

Rhus succedana. (*Anacardiaceae.*) Japan Wax-tree. Small tree of China, Japan, etc.; furnishes Japan Vegetable-wax of commerce, from waxy deposit on berries, obtained by boiling; usually valued at about 80*s.* per cwt. **R. vernicifera.** Japanese Lacquer-tree. Small tree of China and Japan. Resinous juice from wounds in stem becomes hard and black on exposure.

Shorea oblongifolia. (*Dipterocarpeae.*) Dumala, *S.* Large tree of Ceylon only, common in moist low-country; yields a clear resin, suitable for varnishes, etc.

Trachylobium verrucosum. (*Leguminosae.*) Large, spreading tree with smooth bark, native of Zanzibar. Yields Copal-resin, usually found in semi-fossilised state near old trees or where these once existed; used chiefly in varnishes. The small, ovoid, 1-seeded, warty pods are resinous and inflammable.

Vateria acuminata. (*Dipterocarpeae.*) Hal, *S.* A clear, yellowish resin, considered equal to the best dammar, exudes abundantly from stem (*q.v.*). **V. indica.** Indian Copal; White Dammar. Moderate-sized tree of S. India; yields a resin similar to that of above.

Vatica roxburghiana. (*Dipterocarpeae.*) Mendora, *S.* Ceylon and S. India. Tree about 50 ft. high; a clear, yellowish resin exudes abundantly from stem.

INCENSE WOODS & RESINS

Aquilaria Agallocha. Aloes-wood; Eagle-wood (*q.v.*). **A. malaccensis.** Kayu-garu of Malaya; both well-known incense woods.

Boswellia Carteri. (*Burseraceae.*) A small tree of Somaliland. The Gum Olibanum of commerce is obtained from incisions made in the bark and exported from Aden, chiefly for use in incense.

Bursera gummifera and other species (*q.v.*). **Camphor,** see opposite.

Canarium bengalense (*q.v.*).

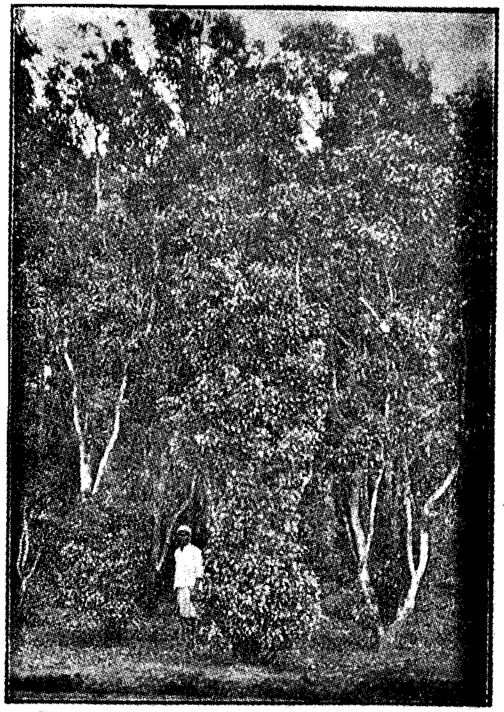
Commiphora Myrrha and other spp. (*Burseraceae.*) Myrrh. Low shrubs of Somaliland, N. India, etc. Yield from the stems and young shoots an aromatic oleo-resin which is of value in commerce, being used in incense as well as in medicine.

Protium heptaphyllum. (*Burseraceae.*) Incense Tree. A tree of Brit. Guiana, where its gum-resin, known as Elemi, is used as incense.

Santalum album. (See *Sandal-wood.*) **Styrax Benzoin.** Gum Benjamin (*q.v.*).

CAMPHOR

The Camphor Tree, or Kapuru-gaha, *S.* (*Cinnamomum Camphora.* Lauraceae), is a moderate-sized, much-branched tree of the Cinnamon family, 30–40 ft. high or more, native of Formosa, China and Japan. The tree is commonly cultivated in these and most other warm countries for ornament or utility. Its low-branching habit and dense foliage adapt it for shelter, windbreaks and hedges. It has been established in the Botanic Gardens at Peradeniya and Hakgala, Ceylon, since 1852 and 1893 respectively. Many up-country estates have also planted small areas, and for some time the crop seemed a promising proposition. About 1,000 acres were estimated to be under young Camphor cultivation in Ceylon in 1908, and the export of prepared camphor for that year was nearly 15 cwt., valued at Rs. 3,075.



CAMPHOR TREES AT EXPERIMENT STATION, PERADENIYA, CEYLON.

Cultivation. The tree, though naturally subtropical, is adapted to a wide range of climate and soil. It grows in Ceylon from sea-level to 6,000 ft., but thrives best at the higher elevations or under subtropical conditions, and is commonly planted for ornament in up-country gardens. Propagation is best by seed, which are usually in season in September–October. About 1,600 seeds = 1 lb. These normally take from 3 to 4 months to germinate, often giving a low percentage of germination. Soaking the seed in hot water for some time before sowing has been found to increase the rate of germination. The tree may also be propagated by root-cuttings, but branch-cuttings are difficult to strike. Seedlings should, if raised in baskets or bamboo pots, be large enough in about 10 or 12 months for planting out.

Planting and yield. For commercial cultivation the trees may be kept at a height of about 5–6 ft., by successive clipping; therefore the plants may be spaced about 6 × 6 ft., *i.e.* about 1,210 plants per acre. Or they may be planted in parallel hedges about 8 ft. apart, with 4 ft. between the plants in the row. In the third or fourth year they should be fit for clipping. Fresh clippings, 6–10 in. long, should yield about 1½–2% distilled camphor, in addition to about 30% of camphor oil. Estimated on results obtained at Hakgala Gardens and on Ambawela Estate, Ceylon, the trees may be clipped 3 or 4 times a year, each tree averaging about 20 lb. of clippings, at which rate an acre should give from 120 to 130 lb. of distilled camphor. In Formosa, the annual yield has been estimated at 120 lb. per acre, and in Florida and elsewhere at from 150 lb. to nearly 200 lb. Fair average camphor commanded £20 per cwt. in 1907; in 1913 it fetched only about £7–£8 per cwt., while during the Great War it was priced at over £100 per cwt. At the

present time (1935) Japanese camphor is quoted at about £6–£8 per cwt. It has recently been found that while certain varieties of the Camphor tree yield both camphor and oil, others yield oil only. The latter kind occurs in Mauritius and some of the W. Indian islands. The question of variety is, therefore, of much importance when growing the tree commercially.

Distillation. Camphor is obtained by steam distillation of the clippings, wood, or roots, and the principle of the process is briefly described thus: The vapour is condensed in a box, which is divided into compartments and placed upside down, in shallow water, in a larger box. Water is allowed constantly to run over the inverted box, keeping it cool and maintaining at even level the water in the larger and shallower box, which acts as a seal. A third box is inverted over the first, and is made in a similar way to condense any vapour that may escape; in both cases holes are made in opposite corners of the partitions in the boxes, in order to cause the vapours to travel by a circuitous route. Solid camphor is deposited on the sides of the condensing boxes and is afterwards scraped off, while crude camphor-oil is skimmed from the surface of the enclosed water. Camphor is used in the manufacture of celluloid, xylonite, disinfectants, smokeless gunpowder, incense, etc.

Synthetic Camphor, which threatens to be a serious rival to the natural article, consists chiefly of a compound prepared from oil of turpentine.

Borneo- or Sumatra-Camphor. (See *Dryobalanops.*)

Nagal Camphor. (*Blumea balsamifera.* Compositae.)—A perennial, shrubby plant, native of Borneo. The leaves when bruised smell strongly of camphor, and are used medicinally by the local inhabitants.

LAC OR SHELLAC

Although not exactly a vegetable product, lac * is dependent on vegetation for its production. It is a resinous substance, of an orange-red colour, secreted by species of scale-insects, chiefly *Tachardia lacca,* which live on the tender branches of certain trees, sucking the juice of the latter and forming on these a continuous waxy incrustation. These insects occur naturally in various parts of the tropics, showing partiality for certain trees and producing heavy secretions on uncultivated trees, which at one time were the only source of lac supply. Now, however, selected species are cultivated for the purpose and systematically infested with the lac insect.

The first introduction of lac into commerce was for colouring purposes, the dye being extracted and the resin discarded. Since the discovery of aniline dyes, however, lac-dye has ceased to be of commercial value, whilst the lac itself has become of great importance for various purposes. In recent years, more especially during and after the Great War, the demand for shellac, *i.e.,* the refined lac, has greatly increased and prices have correspondingly advanced. The industry, however, is a somewhat precarious one, being largely dependent on seasons.

Climate. A hot and moderately dry climate is necessary for successful lac culture, extremes of dry or wet weather being injurious to it. In the chief lac districts in India, three distinct seasons occur, viz. the cold, hot and rainy seasons, while the annual rainfall is about 30–40 in. At Pusa, where lac has been grown successfully for the last several years, the seasons are as follows: Cold season from October to the middle of March; a hot and dry season of 3 months from March to June; and a rainy season from July to the end of September. The average annual rainfall is about 45 in., and the temperature rarely rises above 100° F.

Lac in other Countries. Lac cultivation is carried on to some extent in Cochin China, and efforts have been made to establish it in Formosa, Egypt, W. Africa and elsewhere. Lac is found naturally in small quantities on certain trees in Ceylon, in the drier districts. It is collected to some extent by the peasant lac-workers, and

* *Cultivation of Lac in the Plains of India* (Bull. 142, Agric. Research Inst., Pusa), by R. B. C. S. Misra, B.A.

used by them in the ornamentation of ceremonial staves, furniture, toys, etc., but the industry is small and local. The chief species of insects producing lac here are *Tachardia albizziae* and *T. conchiferata,* which occur mostly on trees of *Albizzia stipulata* (Kabal-mara), *Croton aromaticus* and *Filicium dicipiens.* These, however, do not produce so plentiful an incrustation of lac as the Indian form (*T. lacca*). Efforts have been made to introduce and establish the latter in Ceylon, but so far without success.

Inoculation of Trees. When the trees have attained a suitable size, which may take from about 8 to 9 years, *e.g.* Ber, to 16 years or more in the case of Kusumb, they are inoculated with brood-lac, this being done about a week or a fortnight before the insects begin to emerge or swarm. Healthy sticks of brood-lac, 8–11 in. long and well furnished with lac insects, are selected and tied to the tender branches of the selected and pruned trees. The insects rapidly multiply and proceed to secrete the resinous encrustation (lac) around them. The trees must not be inoculated too young or too heavily, as otherwise their vitality will be affected. It is important that the two ends of the brood-lac sticks when tied in position should each touch the branches. Inoculation should not be done in rainy weather, lest the young insects are washed off the trees.

Showing Lac Deposits on Twigs of *Zizyphus Jujuba.*

Harvesting. In 4–8 months after inoculation, according to season, the insects will have ceased to emerge and the lac-covered shoots (stick-lac) are ready for gathering. These are then cut, a liberal allowance being left on the tree for serving as *brood-lac.* After being dried in the sun for about a week, the lac is scraped off with a knife or crushed by a grinding mill, then dried in the shade. It is afterwards ground, soaked in water for 24 hrs., and thoroughly washed in changes of water, so as to remove as much as possible of the colouring matter (*lac-dye*). The washed, granular material, which is of a pale-orange colour, is the *seed-lac* of commerce. This is heated, then formed into thin sheets (*shellac*). The latter is often blended, according to grades required or uses to which it is applied, with a small percentage of pine-resin and arsenic, the latter being for the purpose of improving the colour. Trade grades are: *T.N.* (the standard grade), *Fine-orange, Garnet-lac, Tongue-lac,* etc.

Yield and Cost. No accurate figures as to yield and cost are available; much depends on locality and host-plant. Cultivation, etc. involves but little labour. Once the host trees are established, the crop requires but little attention, whilst wild trees, or those grown for shade or boundary lines, may be utilised as lac-bearers. Two crops a year may be obtained, one (" Baisakhi " or summer crop) taking about 8 months, occurring between May and August, and another (" Katiki " or winter crop) taking 4 months, viz. October–January. Some trees, *e.g.* Kusum, bear a good

crop only every second or third year. The annual yield of stick-lac per tree may be only 2 or 3 lb., or as much as 20–40 lb. in the case of well-cultivated trees. In the Cent. Provinces of India, an average of 4 maunds (say 320 lb.) per acre is said to be often obtained from "Palas" (*Butea*) trees; taking 110 trees to the acre, this would average over 3 lb. each. Prices fluctuate considerably, the best grades commanding at present (1935) 70*s.*–80*s.* per cwt.

Uses. The uses of shellac are numerous. It is employed in the manufacture of high-grade varnishes, sealing-wax, gramophone records, polishes, backing mirrors, electric insulation, fixing shafts, filling material for explosives, lithographic inks, stiffening hats, and wrappers for chocolates—in this case not blended with arsenic. Inferior grades are largely used for making bangles, toys, and delicate lacquer work. The lac-dye contains a percentage of nitrogen and is sometimes used in India for manuring paddy fields; otherwise it is discarded. India is practically the only source of lac supply, and Calcutta the principal port of export. U. States is the chief consuming country.

Trees suitable for lac culture. The selection of host trees for the insect is of first importance, as on these the quality and yield of lac largely depends. The trees should be fairly quick-growing, adapted to pollarding, and able to withstand heavy infestations of the lac insect. The best is the "Kusum" (*Schleichera trijuga*), whose lac commands the highest price. Next to which are "Palas" (*Butea frondosa*), "Ber" (*Zizyphus Jujuba*), and "Sirrus" (*Albizzia Lebbek*). Other lac-bearing trees are:

Acacia arabica. "Babul" of India. A small tree, adapted to poor soils and dry climate. Bears lac in Sind, etc.
Anona palustris. "Ata," "Alligator-apple."
Cajanus indicus. "Arhar" or "Tur" of India; "Pigeon Pea"; "Rata-tora," *S* (see *Veg. and Food Crops*). Cultivated for lac in Assam, being inoculated when about 2 years old; produces a year later from 3 to 5 lb. or more lac per plant. The lac, however, is rich in colouring-matter, does not bleach well, and is therefore classed as an inferior grade.
Croton aromaticum. "Wel-keppitiya," *S*; **C. lacciferus,** "Keppitiya," *S.*
Ficus glomerata. "Crattock" or "Guler" of India. **F. religiosa,** "Peepul" or "Pipal" tree of India, "Bo-tree" of Ceylon. Common all over India, Burma, etc. Bears inferior lac, used chiefly by local bangle makers. On religious grounds, however, it is often unsuited as a lac tree.
Filicium decipiens. "Pehimbiya," *S* (*q.v.*).
Harpullia cupanioides. "Na-imbul," *S.* Medium-sized tree.
Mangifera indica. Mango.
Pithecolobium Saman. "Inga-saman," "Guango," or "Rain-tree."
Shorea robusta. "Sal" of India; and **S. Talura,** "Jalla" or "Jalari."

Chinese Insect Wax. A wax similar to Lac is produced in China by a scale insect (*Coccus pe-la*). The insects live on the branches of various trees, especially *Ligustrum lucidum*, and are propagated by transferring infested branches from tree to tree. These soon become covered with a waxy secretion, which is collected and used in China in furniture polishes, candle-making and other purposes.

CHAPTER XXIX

FIBRES, ETC.

(1) *COMMERCIAL FIBRES.* (2) *OTHER FIBRE PLANTS.* (3) *PITH PLANTS, OLAS, ETC.* (4) *RATTANS OR CANES.* (5) *SERICULTURE.*

Most vegetable fibres consist of the fibro-vascular tissue or thread-like filaments forming the tougher parts of plants, their function being primarily for rigidity. They may be classified botanically into *bast fibres* (inner bark), *e.g.* Jute, Hemp, Ramie, etc.; *leaf fibres* (*e.g.* Manila-hemp, Sansevieria, Agave, Phormium), and hair-like or *floss fibres* surrounding the seeds of certain fruits (*e.g.* Cotton and Kapok). Coir-fibre consists of the husk (mesocarp) of the coconut. Commercially, fibres may be classed into *Textile fibres* (including Cotton, Flax, Ramie, Hemp); *Cordage fibres* (including Manila-, Sisal-, Mauritius-, and New Zealand-hemps); *Bristle, Brush* or *Mat fibres* (*e.g.* Piassava, Coir, Palmyra); *Stuffing fibres* (Kapok and other silk-cottons); and *Paper-making fibres*, which include various fibrous or waste materials capable of pulping and felting.

Fibre plants are numerous in the tropics, but the great majority lack certain essential qualities for commercial cultivation, whilst many present difficulties of successful decortication. One of the chief uses of the coarser fibres, *e.g.* Sisal, Phormium, etc., is for binder twine in corn- or wheat-growing countries, as Australia, Canada and America. Owing, however, to the introduction of the "Combined Harvester-Thresher" the demand is likely largely to diminish, as this machine cuts and threshes in one operation, so that no binder is needed. The fibre market, like many others, has of late fallen on evil days, but only temporarily it is hoped, for fibres are among the most important products of the vegetable kingdom.

Cotton; Pulun, *S.* The cotton of commerce consists of the delicate hair-like fibres or floss which surrounds the seeds of various species of *Gossypium* (family Malvaceae). These are shrubby perennials, but are usually cultivated as annual crops, partly in order to guard against insect pests. Cotton is the most important of all textile fibres, and has been grown and used in India from time immemorial. It is also largely used for gun-cotton and ammunitions. The principal cotton-producing countries are the U. States, Egypt, India, Brazil, W. Indies and Japan.

Cultivation. The cotton plant requires a rich, friable, deep soil, a black humous land being considered the best; a warm climate with a rainy season of 2 or 3 months, followed by a dry period for the successful maturing and harvesting of the crop, is indispensable. It is a subtropical rather than a tropical crop. Manuring is essential. Nitrate of soda is favoured in Sudan and Egypt, being applied at the rate of about 2 cwt. per acre. Sprinkled along the lines when the plants are a few inches high, it is found to be a good remedy for the cut-worm pest besides being an excellent fertiliser.

In some of the principal cotton-growing countries, where the annual rainfall may be under 25 in., irrigation is indispensable, as in Egypt, India, Mesopotamia, etc. Shade trees must be avoided, but windbreaks are beneficial where strong

winds occur. The seeds, which must be fresh, should be sown in the rainy season, so as to allow of the crop being harvested in the dry season. The land being ploughed and harrowed, the seed is sown in rows about 3 or 4 ft. apart, with a distance of about 2 ft. between the plants in the row. It is usual to sow 3–4 seeds to the hole, a few in. apart, taking about 8–10 lb. seed to the acre. They germinate in a week. When a few in. high, the weaker seedlings are removed and the strongest one (or two) left to each hole. If the ground be flat and rather wet, the soil should be thrown up in drills, but in dry regions level, or even sunken, cultivation is best. Vacancies should be supplied early, preferably by seeds, as plants do not bear transplanting well.

Harvesting. The crop is ready for picking in 5–6 months (according to variety) from the time of sowing, and harvesting may continue for 4–6 weeks or longer. In Ceylon, it is best to sow in October or November (rainy season), the crop thus maturing in March–May, which is generally a dry period. When ripe the pods burst open and the cotton bolls are picked by hand. The lint is afterwards thoroughly dried in the sun, thus getting rid of " stainers " and other insects, then separated from the seed by a ginning machine, after which it is made up into compressed bales of about 500 lb. each for export.

Grading and Yield. Grading must be carefully attended to, it being essential to sort the fibre according to quality into 2 or 3 uniform grades. 40–50 pods per plant is considered a fair crop, though some plants may bear as many as 100 pods. 50 pods should yield 1 oz. clean cotton. The yield per acre varies, according to climate, soil, and variety, from 700 to 1,500 lb. or more of seed-cotton, about 950 lb. being a good average. In S. United States and Egypt a yield of 600–700 lb. or more ginned cotton per acre is often obtained. Ginned cotton (*i.e.* freed from the seeds) is about half the weight of seed-cotton. The seeds also are a source of revenue (see *Oils*). Cotton may sometimes be grown as a catch-crop, as with young Rubber or Coconuts, etc. The production of cotton in Ceylon is at present limited to a small area, chiefly in the S. Province, and the crop is nearly all used by local mills.

Varieties. Numerous species or varieties of *Gossypium* are known, either in a wild state or in cultivation, being distributed over the tropics of Asia, Africa, and America. Many of the types in cultivation have special qualities suited to certain localities, climate and soil. Their commercial value depends mainly on the length and lustre of the fibre or lint. Their botanical origin is confused, but the principal sorts are considered to have been derived chiefly from the following species, viz.: *G. barbadense*, the source of " Sea Island " type, the finest and longest of all; it has a silky fibre $1\frac{5}{8}$–$2\frac{1}{4}$ in. long and is cultivated in regions near the sea, as in the W. Indies; *G. peruvianum*, affording the " Peruvian " and " Egyptian," among the best varieties of the latter being the " Mitafiffi," with a fibre length of 1·3–1·5 in. *G. hirsutum* is considered to be the origin of " American Upland " cotton, with a fibre about 1 in. long; this is the most largely cultivated type and is in greatest general demand. *G. herbaceum*, a short-staple type, yields the " Indian " or " Tinnevelly " cotton. " Durango " and " Cambodia," forms of *G. hirsutum*, are especially suited to the tropics, and have given yields of 1,037 lb. and 626 lb. respectively per acre in Ceylon. *G. arboreum* is a tree form which attains a height of 15–20 ft., considered a native of Africa, but is not cultivated for fibre. " Caravonica," a hybrid tree-form raised in Queensland, is claimed to give heavy yields and to be adapted to perennial cultivation. " Allen's " and " Sunflower " varieties are said to have proved superior to " Egyptian Cotton " in Uganda. Long-staple varieties thrive in Lower Egypt, where they yield about 300 lb. cleaned cotton per acre. " Mesowhite " is favoured in Mesopotamia. " Nanking Cotton " (*G. Nanking*) has a reddish-brown floss and is cultivated in Siam and China. It is known as " Khaki " cotton, and has certain advantages locally over white cotton.

Flax or **Linseed.** (*Linum usitatissimum.* Linaceae.)—An erect annual, cultivated from early antiquity in Egypt for its fibre, and now largely in India, Argentina, China, etc. for its seed (see *Linseed Oil*). Its cultivation has in recent years been undertaken at the higher elevations in E. Africa. The crop, however, is not suited to the tropics. About 2 months from sowing, the plants begin to flower and assume a yellowish colour; 3 weeks later the seed capsules become brownish-yellow. The fibre is then at its best, and the plants should be pulled by hand, not cut. If, however, the crop is grown for seed it must not be pulled till the seed capsules are quite brown and ripe.

Harvesting. The stems, as they are pulled, are left in handfuls in lines on the field for 4 or 5 days to dry. They are then tied in small bundles, which are placed flat between poles set in the ground 2 ft. apart, the ground between being first covered with dry grass. In 3 weeks' time the straw should be thoroughly dry. It is then placed in stacks, the top-ends inside and the bundles sloping upwards. When cultivated for fibre only, the crop should be pulled just after the plants have flowered, the fibre being then at its best.

Threshing or removal of the seed is done either by drawing the flax by hand through iron pins closely set in a block of wood, or by a special machine. The straw is then made up in bundles, one-half with the roots coming next the tops of the other half. Each bundle is tied at either end and in the middle with thin twine.

Retting. The bundles are placed upright, close together, in a tank supplied with running water; wooden planks weighted down with stones are placed on top, and water is turned on. In 6–8 days the water is drained off, the bundles are removed, laid out in lines, and left for about a couple of days to dry and bleach. The straw is again made up in bundles and again placed in the tank for 4–6 days. In cold weather as much as 30 days in all may be required for the process of retting, which is not complete till the fibre separates readily from the straw.

Breaking. The next operation consists of breaking or crushing the wood in the " straw," without damaging the fibre, by passing the straw between two fluted rollers, driven either by hand or steam. The next process is *Scutching*, by which the straw is put through a machine with hard wooden blades, which remove the wood from the fibre. The flax (fibre) is then finished, made up into bundles averaging 14 lb. each, tied in three places, with the roots all to one end. It is then made up into bales of about 200 lb. each, and covered with hessian for shipment.

Cultivation and yield. A rich clay soil gives the best flax, a light sandy soil producing too short a straw. The stems should have a length averaging 36 in. In Kenya seed is sown in drills about 4 in. apart, about 80 lb. of seed going to the acre. The usual rate in Belgium is 120 lb. to the acre, owing to the greater loss in that country caused to seed and young plants by birds and unfavourable climate. At Kabete, in Kenya, a 5-acre field averaged over $2\frac{1}{2}$ tons of straw per acre, and a sample of straw, taken haphazard, gave: 17 lb. of seed (= 496 lb. per acre, or $8\frac{1}{2}$% weight of straw), 21 lb. clean fibre (= 613 lb. per acre, or $10\frac{1}{2}$%), and 8 lb. waste fibre, removed during the process of scutching (= 291 lb. per acre, or 5%). The average yield of seed per acre in India is about 300 lb.

Hemp, Indian. (*Cannabis sativa.* Urticaceae; Nettle family.) See *Drugs*.—An annual dioecious shrub, growing to a height of 6–8 ft. or more, with erect stems and small, greenish flowers, native of Cent. Asia and long cultivated in Persia, India, China, etc., either for the fibre obtained from the stems by retting, or for the drug ganja (*q.v.*). It is cultivated for fibre chiefly in S. Europe, S. Africa, Mexico, U. States, Kashmir, China, Japan, etc.

Cultivation. The crop may be grown in any warm climate with a moderate rainfall, and prefers a rich friable soil. With manuring, it may be grown on the same land for several years in succession. Applications of potash fertilisers are especially beneficial, and all refuse from the retting and scutching processes should be returned to the soil. Seed is sown broadcast or in drills. In order to produce straight clean stems and the best fibre, close spacing is adopted, $2\frac{1}{2}$–3 bushels seed per acre being usually allowed. Hemp seed yields an oil of value in commerce, and is quoted at about 20*s.* per cwt.

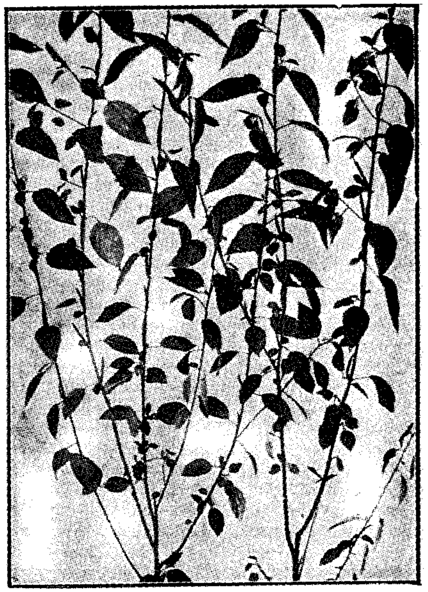
Yield. An average crop should give 2–3 tons of dry stems per acre (yielding about 25% of clean fibre), or 25–30 bushels of seed. The best hemp, when ready for market, is nearly white, with a silky lustre, and is 6 ft. or more in length. Italy produces the best quality of hemp, the price of which fluctuates from £30 and £50 per ton, according to quality. The fibre is used chiefly for ropes, cables, twine, nets, sail-cloth, canvas, warp of carpeting material, etc.

Jute or **Gunny-fibre.** This valuable fibre is obtained from the stems of cultivated varieties of *Corchorus capsularis* and *C. olitorius* (Tiliaceae),

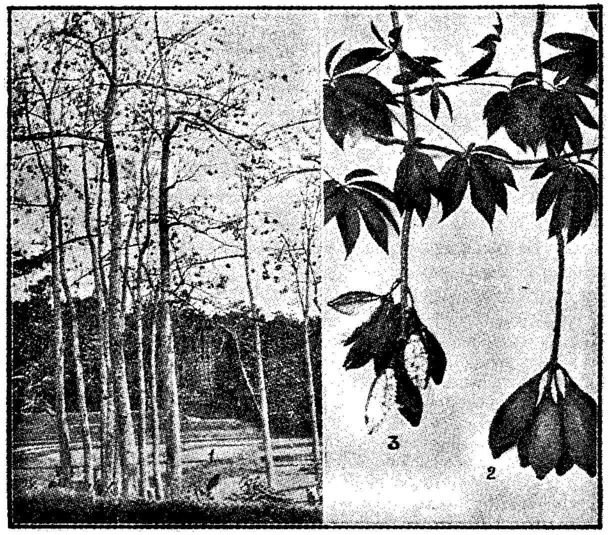
annual plants with long, erect, thin stems and yellow flowers, indigenous to Ceylon, India and Malaya. In cultivation the plants, being grown closely together, attain a height of 6–10 ft. or more. Of the numerous varieties, those of *C. capsularis* are generally preferred, as they yield better fibre and come to maturity earlier than those of *C. olitorius*.

Cultivation. The crop thrives in rich, loamy or alluvial soil, on flat or low-lying land, with provision for irrigation. The latter is essential in the early stages of the crop, but the plants must not be long submerged. Jute is an exhausting crop and requires manuring. Cattle manure, ploughed in before sowing at the rate of 3–4 tons per acre, gives good results, but the application of potash fertilisers is of special importance. Rotation with mustard, rice, pulses, etc., is generally adopted; or such crops may be grown and dug in as green-manure.

Seed is sown broadcast at the rate of about 8–10 lb. per acre, the seedlings being thinned out when about 1 ft. high to a spacing of about 6 in. The crop matures in 3–4 months and is cut when the plants are in blossom. The stems are cut near the ground, bundled and stooked for a few days, then retted in a tank or pool of water. Retting takes about 10 days. The yield of fibre may vary from 1,200 to 2,000 lb. per acre, but is sometimes much more.



JUTE (*Corchorus olitorius*, var.). Largely cultivated in Bengal.



KAPOK (*Eriodendron anfractuosum* (= *Ceiba pentandra*)). Showing (1) Trees in fruit and deciduous, (2) Pods in clusters, and (3) Ripe pods displaying white cottony contents.

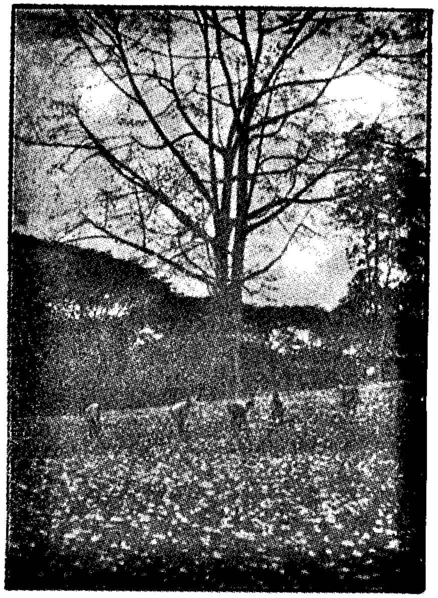
Jute forms a large industry in India, chiefly in Bengal, where some 3 million acres are yearly under the product. The fibre is extensively used for cordage, coarse carpets, fishing nets, gunny bags, etc. It fluctuates much in price, and is at present quoted in London at £16 to £18 or more per ton.

Kapok or Silk-cotton ; Pulung or

Kotta-pulung, *S.* (*Eriodendron anfractuosum*, = *Ceiba pentandra*. Bombaceae.)—A large or moderate-sized, quick-growing, upright, thornless tree, branching horizontally, in whorls, at right-angles to the stem. It thrives from sea-level to 2,500 ft., and is deciduous in the dry season, usually February–April, the greenish-white flowers being produced in clusters shortly after the leaves have dropped. The pods, which ripen about $2\frac{1}{2}$–3 months after flowering, contain a quantity of creamy-white floss (kapok), consisting of lustrous, unicellular hairs about $\frac{1}{2}$–1·2 in. long, closely packed around the black, small pea-like seeds, and when ripe burst open and disperse their contents. The pods should therefore be collected before they are quite ripe, then dried in the sun, and shelled.

Until lately, kapok fibre has been used chiefly for stuffing pillows, cushions, etc., and during the war for life-saving waistcoats and similar articles. Recently, it has been employed for mixing with other fine fibres for textile purposes. The largest supply comes from Java and the Philippines, where the tree is cultivated to some considerable extent. The export of kapok from Java alone is about 12,000 tons a year. Some 430 tons were exported from Ceylon in 1929, valued at about £89 per ton. Cleaned kapok is now valued in London at about 8*d.* per lb., Java kapok usually fetching the highest price. The tree is readily propagated from seed, but preferably from branch or post cuttings planted *in situ*, and thrives from sea-level to about 2,000 ft. Spacing for field planting may be about 15 × 15 ft.; for roadsides or boundaries, the trees may be planted 8–10 ft. apart and used as supports for pepper vines.

Yield. The trees begin to yield in the fourth or fifth year, when they may be expected to give $1\frac{1}{2}$–2 lb. of kapok each, or 1 lb. for 80 or 100 pods. Trees vary considerably in yield; some may bear heavily one year and be almost barren the next. A good tree at maturity (say 15 years old) may produce from about 600–900 pods, or 6–9 lb. of clean floss. A single pod contains from about 100–150 seeds, 200 of which when fresh = 1 oz., and about 180,000 or 50 lb. = 1 bushel. By weight, the dried pods contain about 50% seeds, 35% floss, and 15% core.



RED COTTON TREE (*Bombax malabaricum*). See p. 80.

Other allied species yield a silky floss similar to kapok. That of *Bombax malabaricum* (*q.v.*) is said to be exported from India under the name of kapok. It does not, however, appear to be collected anywhere in Ceylon, owing doubtless to the difficulty of access to this very prickly, large, erect, bare-stemmed tree.

Manila Hemp ; Abaca Fibre. (*Musa textilis*. Scitamineae.)—A large herbaceous perennial or small tree of the Banana family, indigenous to the Philippines, where it is extensively cultivated for its well-known fibre. The plant requires a hot and moist climate, deep heavy soil, with a good rainfall, and is best suited to elevations below 1,000 ft. Its cultural requirements are similar to those of the Plantain or Banana, which it closely resembles. It does not bear edible fruit. Hemp planta-

tions in the Philippines are confined chiefly to flat and volcanic land, as in the eastern side of the Islands.

Propagation is by suckers (fertile seeds being rarely produced), which are planted out when about 3 ft. high, at distances of about 8 × 10 ft. These produce several stems (suckers), forming a clump, like the Banana. To obtain the fibre, the soft succulent stems, formed by the leaf bases, are cut down just before they begin to flower (the fibre being then at its best), about a foot from the ground. After removal of the leaves each stem is divided into strips about 3 in. wide. To clean the fibre, each strip is taken by hand and drawn between a blunt knife and a hard smooth board, which are attached to a light frame. One man can thus clean 20 lb. of fibre per day. The hemp is then bleached, dried in the sun, and made up in bales of 275 lb. for export. The inner portion of the stem yields the finest quality of fibre.

Yield. The first crop of fibre is obtained about 2 years from planting, and a full crop in the 4th year, the plantation continuing to yield for 15 or 20 years. The annual yield varies from 1½ to 2 tons per acre. A single plant may give 3–5 lb. of dry fibre, or about 2% of stem by weight. The fibre as prepared for market is composed of strands 6–10 ft. long. It is very strong, light and tenacious, and its principal use is for ropes and cordage, which are noted for their superior quality. The quality of the fibre depends on climate, soil, and variety. It fluctuates in price, according to grade, etc., being now about £13 per ton against £25 to £30 in 1926.

Sunn or **San Hemp**; Bombay Hemp; Hanna, *S.* (*Crotalaria juncea.* Leguminosae.)—An erect annual, 6–10 ft. high, with bright yellow flowers, native of Trop. Asia generally, commonly occurring in the dry region of Ceylon; cultivated practically all over India and to a small extent in the semi-dry districts of N.-W. Ceylon, generally as a catch-crop, for the sake of the strong and useful fibre obtained from the stems by retting. The plant may also serve when young as fodder for cattle, or for green-manuring. For fibre purposes, it is best grown on a light soil, in rather dry districts. The seed is sown thickly, either broadcast or in drills, at the rate of 20–25 lb. (40 lb. if for green-manure or fodder) per acre, the seedlings being afterwards thinned out to 3 or 4 in. apart. In India the crop is sown at the beginning of the rains and occupies the ground for 3½–4 months, being cut, if for fibre, when the plants blossom.

Harvesting. In harvesting, the plants are usually pulled up by the root, though sometimes cut close to the ground, and left on the field for a few days to wither; they are then stripped of the leaves and tied in bundles of about a hundred stalks. The bundles are dried for 2 or 3 weeks, then placed in pools (preferably of still, shallow water) and weighted down with logs. Retting is complete in 6–8 days. The fibre is afterwards stripped off, washed and bleached.

Yield, etc. A good average crop should yield 3–4 tons of dry stems per acre, which furnish about 8% of clean fibre; hence the yield of fibre per acre should be about 5 or 6 cwt. The fibre is now valued in London at about £12 per ton, varying according to grade. It is used chiefly for cordage, canvas, fishing-nets, etc.

Mauritius Hemp; Green Aloe. (*Furcraea gigantea.* Amaryllideae.)—A large, succulent perennial, indigenous to Trop. America, bearing large fleshy leaves, 5–7 ft. long, producing at maturity a central "pole" (inflorescence) 20–25 ft. high, which bears numerous bulbils. Introduced to Ceylon before 1824, the plant has, as in India, etc., become almost naturalised, especially up-country and near railways, along which it was once planted to form a boundary. First introduced to Mauritius about 1790 as a garden plant, it gradually spread over waste lands and became completely naturalised. About 1875 an industry of extracting the fibre was started there, followed by the cultivation of the plant on commercial lines, spacing being 5 × 5 ft. in light soils, and 7 × 7 ft. in heavy soils. The leaves yield 2–3% of strong white fibre, used for ropes, twine, sacks, mats, etc. The plant resembles Sisal Hemp (*q.v.*), but is readily distinguished by the pale-green and thinner leaves, which are furnished with short spines along the margins from about the centre towards the base. Propagation is by bulbils or suckers. Two varieties are recognised in Mauritius, viz. "Creole Aloe" and "Malgach Aloe," the former giving a larger percentage of fibre. See fig. on p. 407.

New Zealand Hemp. (*Phormium tenax.* Liliaceae.)—A herbaceous, perennial, bushy, stemless plant with sword-shaped leaves, which are either green or margined and streaked with white; these are 6–8 ft. long and grow from the base in the form of a fan. It is indigenous to New Zealand, where it covers large areas of swamp land, especially in the south of the North Island. Here the crop grows wild, the only cultural attention given being the removal of surface water by drains and canals; these and general protective measures are estimated to cost about £1 per acre a year. (See *Ornamental Plants.*)

Cultivation and yield. The plant is suited to a warm temperate or subtropical climate and deep, heavy, moist soil. Propagated by seed, preferably by suckers; plants may be spaced 3 × 1 ft. A crop may be obtained 3 years after planting and once in 3 years thereafter, the average yield being about 25 tons of fresh leaf, producing about 10% of fibre, or about 2 tons per acre. The fibre has a high breaking strain and is valued for binder twine, ropes and cordage. It commanded about £30 or more per ton in 1925. The plant has been introduced and cultivated commercially in St. Helena on an extensive scale.

Varieties. Several varieties are recognised. The following are among the best in New Zealand: "Tehori," white fibre, very prolific. "Nagaru," much prized by the Maoris. "Nagaturoa," one of the best. "Mukama," said to have been sold in London for £70 per ton before the War.

Panama Hat Plant; Jippi-jappa or Hippi-happa; Toquilla Palm. (*Carludovica palmata.* Cyclanthaceae.)—A stemless bush with large, palm-like leaves, similar to those of a fan-palm, with stalks 5–6 ft. long. The flowers, followed by the seed, are produced in cones borne on short stalks rising from the base. A native of Trop. America, it is extensively cultivated in parts of Ecuador, Colombia, etc., for the sake of the leaves, from which the well-known Panama hats are made. The plant is fully developed when about 3 years old, and lives for many years in the same ground. The young leaves are taken once a month, just as they begin to unfold, the stalk being cut 8 or 10 in. below the leaf-blade to facilitate handling.

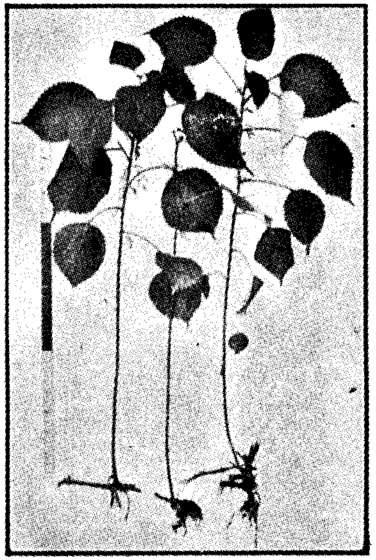
PANAMA HAT PLANT OR JIPPI-JAPPA (*Carludovica palmata*). Showing fruit spikes (1).

Each leaf is torn into ribbons about ½ in. wide, and then into shreds by means of an instrument consisting of a piece of wood in which needles are fixed, the larger ribs being rejected. These ribbons ("straw") are submerged in boiling water for about 10–15 minutes, being then dried in the sun for 3 hrs., then bleached in a sulphur chamber for a day. The "straw" (toquilla) is sold locally at the equivalent of about 2*s.* per lb. From 8–12 leaves are required to make one hat. A coarse hat can be made in one day, but the best will take 18 days to complete. Introduced to Ceylon in 1866, the plant grows luxuriantly from sea-level to 2,500 ft., preferring a moderately moist, heavy soil and light shade; the latter, however, is not essential.

Toquilla straw is also obtained from *Carludovica jamaicensis*, and from the young leaves of species of *Pandanus* and Palms, *e.g.* the Ita Palm (*Mauritia flexuosa*) of S. America, and made into hats, baskets, etc. Similar hats and other articles are

made in Manila from the tender leaves of *Pandanus utilis*, and in Ceylon from those of *Phoenix zeylanica* (*q.v.*).

Ramie, Rhea-fibre, or "China-grass." (*Boehmeria nivea*. Urticaceae or Nettle family.)—A perennial shrub, 5–7 ft. high, with large, heart-shaped, crenate, hairy leaves, greyish-white beneath, indigenous to parts of tropical and subtropical Asia, and cultivated in China, Japan and Formosa. From the inner bark of the stems is obtained Ramie or Rhea-fibre of commerce, which is pure white, of a silky lustre, and is used in the manufacture of fine linen, gas mantles, etc. The plant thrives in loamy, alluvial or humous soil, up to about 3,000 ft., and requires a warm moist climate for profitable cultivation. It grows well in partial shade, but this is not necessary once the plants are established. The crop is of an exhausting nature, so that good cultivation and manuring are essential. Excessive moisture or drought affects the quality of the fibre.



China-grass, Rhea, or Ramie Fibre (*Boehmeria nivea*).

Propagation and Planting. Propagation is usually by cuttings or suckers, preferably the latter. The soil being dug or ploughed to a depth of 8–10 in., the plants may be spaced about 2 × 3 ft. The production of straight, clean, unbranching stems is essential. Replanting should not be necessary for about 6 or 7 years, and attention to weeding and cultivation is important. A small crop of stems may be obtained about 10 months after planting, and cutting rounds may afterwards be made 2 or 3 times a year. The fibre is not separated from the stems by retting, as in the case of other similar fibres, but is removed either by hand or a decorticating machine. It is then subjected to a chemical process of *degumming* in order to remove the gummy substances present.

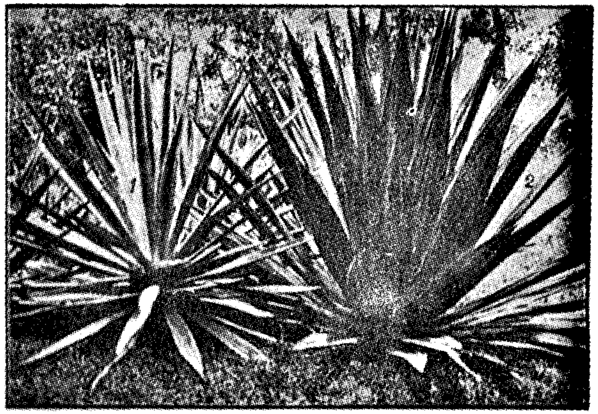
Yield. The annual yield is estimated at about 20 tons of canes per acre, giving about 1 ton of dry ribbons, which furnish about 50% of degummed fibre or *filasse*. The latter was valued in London in 1925 at from £35 to £40 per ton. The difficulty of decorticating the fibre and removing the gummy substances referred to is the principal drawback to its commercial utilisation. Experimental trials have been made in Ceylon, but notwithstanding satisfactory growth and cheap labour it failed to become an established product.

Varieties. Boehmeria nivea, var. *tenacissima*, which also furnishes rhea-fibre, has smaller leaves, which are green (not white) underneath, and is probably suited to higher elevations than the preceding species. *B. pulchra* has large, dark-green, velvety-looking, dentate leaves, and is worth growing for ornament. The name "Wild Rhea" is given in India to *Debregeasia velutina* (*q.v.*).

Sisal Hemp or **Henequen.** (*Agave sisalana*. Amaryllideae.)—A perennial stemless plant, native of Cent. America, introduced and cultivated commercially in E. Africa, Mauritius, W. Indies, Philippines, Dutch E. Indies, etc.; introduced to Ceylon in 1890. Sisal-hemp of commerce is furnished by the thick succulent leaves, which are 4–6 ft. long, smooth-edged, with a sharp, terminal, dark-brown spine. The plant flowers when about 7 or 8 years old, producing a central "pole" (spike) 15–20 ft. high, which should be cut down, unless required for the bulbils, at 4 ft. from the ground; otherwise the growth of the leaves and the quality of the fibre will be affected. The "pole" does not usually produce seed, but if allowed to mature will bear from about 1,500–2,000 or more bulbils, by which the plant reproduces itself.

Cultivation. The plant thrives on well-drained limestone soil in a hot and dry, or only moderately wet, climate. It is drought-resistant, and requires but little cultivation beyond keeping weeds in check and removing suckers. Propagation is by bulbils, as above stated, or suckers. On fairly good soils these may be planted out about 8 × 6 ft., or closer in poor ground. One-year-old bulbils from nursery beds are best for planting; suckers usually "pole" earlier and are less uniform in size. Catch-crops may be grown between the rows for the first 2 or 3 years.

Yield. The first cutting of leaves may usually be made about 3 or 4 years after planting, the lower and mature leaves (not less than 3½ ft. long) only being taken. These may average for the first year about 25 leaves per plant. Subsequent cuttings may be made once or twice a year, and extend over 4–5 years, averaging a total of about 150–180 leaves for each plant. The plantation has then to be renewed, after the ground has been cleared and allowed to lie fallow for a year. In Mexico, where growth is comparatively slow, these periods may be considerably extended, the life of the plants being often as much as 10–15 years or more, but the yield is lower. A heavy rainfall and rich soil reduce the percentage of fibre, but increase the leaf and therefore the yield. The yield of fibre is about 3% in a wet climate, and 4% in dry, or about 1½ tons per acre. It is estimated that 1,000 leaves should give 40–50 lb. of prepared fibre. The latter must be extracted within 24 hrs. of cutting the leaves. It is then cleaned, placed on lines in the sun to bleach and dry, and afterwards baled for shipment. Sisal is used largely for ropes, cordage, and binder twine. It is now (1935) quoted in London at about £20 per ton, against £42 in 1926.



(1) Sisal Hemp (*Agave sisalana*).
(2) Mauritius Hemp (*Furcraea gigantea*).

Yucatan Hemp, Henequen, or **Mexican Sisal.** (*Agave fourcroydes*.)—A distinct species, the leaves of which are of a glaucous hue, often with spines along the margins. This is the principal fibre plant of Yucatan, which furnishes about 90% of the Sisal of commerce exported. It is said to yield a larger percentage of fibre than the Sisal plant, though considered inferior to that of the latter. Cultural requirements the same as for Sisal; but the very spiny leaves are a drawback from a cultural standpoint. (See "Zapupe Fibre.")

OTHER SOURCES OF FIBRE

Abroma augusta. (*Sterculiaceae.*) Devil's Cotton; Ulatkambal.—Tall, quick-growing shrub of India and Java, with large angular leaves. Fibre from stems, obtained by retting, used for ropes and cordage.

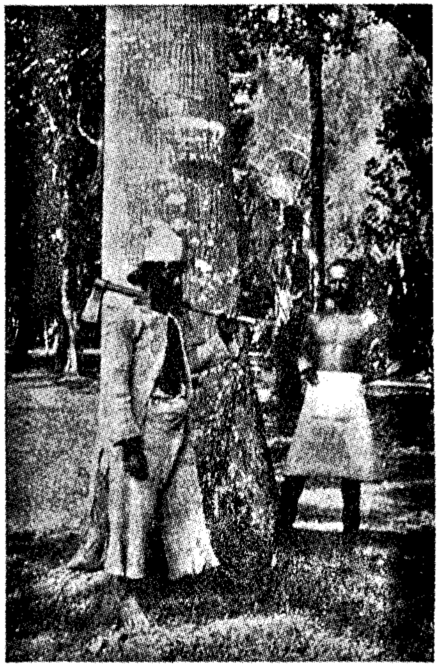
Abutilon Avicennae. (*Malvaceae.*) Chinese Jute; Indian Mallow.—An annual extensively cultivated in China for its fibre, yielding about a ton per acre.

Adansonia digitata. Baobab Tree. Fibre from inner bark used for ropes and cordage. Cultivated in parts of India, Madagascar and Africa (*q.v.*).

Agave Cantula. Maguey or Cantala Fibre. Cultivated in the Philippines and in Java, and known as "Cantala." Usually planted 6 × 6 ft. The leaves are ready for cutting in from 4 to 5 years from planting, each plant producing 25 or 30 mature leaves a year for 2 or 3 years, yielding 2–3% fibre, or about 1½ tons per acre. Cutting may be carried on for about 3 years, when the plant ceases to be productive.

Allaeanthus zeylanicus. Alandu, *S.* (*Urticaceae.*) A small, spreading tree of Ceylon; yields coarse fibre used for ropes, etc.

Ananas Magdalenae. Wild Pineapple; Pita Fibre, or Colombia Pita. (*Bromeliaceae.*)—A stemless plant, with leaves 8–10 ft. long, 3–4 in. broad at the butt end, hooked spines along margins, forming large areas ("pitales") of forest undergrowth, chiefly at medium elevations, in Colombia, etc.; thrives under natural shade and in friable humous soil. The leaves yield strong, durable and hard fibre of considerable length. Propagation by suckers, and an acre of 5,000 plants is estimated to yield 1¼ tons of fibre. **A. sativus.** Pineapple Fibre. Certain varieties of Pineapple yield good fibre, for which they are cultivated in Formosa, Philippines, and S. China, the fibre being used in textile fabrics. 1 cwt. of the leaves yields about 2½ lb. of prepared fibre. A variety known in the Philippines produces a fine quality of fibre used for fine weaving, as in the celebrated "pina" cloth of that country.



Bark-cloth Tree (*Antiaris innoxia*). Showing garments made from inner bark: *left*, a complete suit; *right*, a sarong.

Antiaris toxicaria (A. innoxia). Sack Tree; Upas Tree; Riti, *S.* Large tree of Ceylon, Java, Moluccas, etc. The dense inner bark, after retting and beating, furnishes a thick fibrous material formerly used for ready-made clothing. Bark-cloth is also furnished by other trees, e.g. *Ficus natalensis*, *Brachystegia sp.* in Uganda, *Broussonetia* in the Pacific Islands, and *Couratari sp.* in S. America.

Arenga saccharifera. Gomuti-fibre. Bristles obtained from leaf-sheaths exported and used commercially for brushes. (See *Sugar Palm.*)

Arghan Fibre. A trade name for a species of Bromeliad (*Bromeliaceae*), a family of herbaceous stemless and mostly spiny plants, extensively distributed over parts of Trop. America, forming a dense undergrowth. Several of the larger species yield excellent fibre, but are hardly adapted for cultivation. (See *Bromelia*, also *Ananas.*)

Asclepias curassavica. (*Asclepiadeae.*) Erect shrubby perennial of the W. Indies. Fine fibre obtained from stems used for textile fabrics, etc.

Bauhinia racemosa. Mayila, *S.* (*Leguminosae.*) Small tree of Ceylon, India, and Malaya. Fibre from inner bark used for ropes and cordage.

Bromelia Pinguin and other species. Large, spiny, pineapple-like plants, yielding a fibre known as Pinguin, Wild-pineapple, Bromelia-pita, or Colombia-pita. Leaves 7–9 ft. long, spines curved forward. Introduced to Ceylon before 1864, now common in hedges about Negombo, etc. (See *Arghan.*)

Broussonetia papyrifera. Tapa- or Kapa-fibre; Paper-mulberry. (*Moraceae.*) —Medium-sized tree of Pacific Islands, with large ovate leaves. Often cultivated commercially on the coppice system in order to obtain long, clean shoots. From these the bark is stripped in ribbons, which after retting yields a fine white fibre. This is

joined with arrowroot and beaten together to form the famous "tapa" or "kapa" cloth, which at one time formed the wearing attire of the natives.

Calotropis gigantea. Akund-fibre, Madar-fibre, Wara, *S.* Manakovi, *T.* (*Asclepiadeae.*)—An erect shrub, 6–10 ft. high, common in Ceylon, India, Malaya, etc. Yields from the stems a fine hemp-like fibre, used for fishing-lines, etc. Silky floss from fruit used for stuffing pillows, cushions, etc.

Cocos nucifera. Coir or Coconut-fibre. See *Coconut Palm.* Husk of fruit, after retting, yields useful fibre largely employed for mats, matting, mattresses, brushes, coarse yarn, cordage, etc., being graded according to uses required for. 27,250 Tons exported from Ceylon in 1933, valued at about 4*s.* 6*d.* per cwt.

Cyperus corymbosus. A sedge of Ceylon, India, etc., 4–5 ft. high. Stems used in India for ropes, grass-mats, etc. *C. dehiscens*, common in marshy places in India and Ceylon, is also commonly used for grass-mats known in Ceylon as "Panpeduru."

Cyperus Papyrus. Egyptian Papyrus (*q.v.*). The pithy stems (leaf-stalks) furnished the ancient papyrus paper of the Egyptians, for which purpose it is still used to some extent. (See *Sedges and Grasses.*)

Debregeasia velutina. Wild Rhea; Gas-dul, *S.* (*Urticaceae.*) Small tree of Ceylon, India, Java, etc. Inner bark affords strong fibre, used for ropes, etc.

Eryngium pandanifolium. (*Umbelliferae.*) Leaves yield the Caraguata-fibre of S. Africa.

Grewia microcos. Keliya, *S.* (*Tiliaceae.*) Large shrub, common in low-country of Ceylon, India, Malaya, etc. Stems yield strong fibre.

Gyrinops Walla. Walla-patta, *S.* (*Thymelaeaceae.*) Small tree of Ceylon; inner bark yields strong fibre used for ropes.

Helicteres Isora. Liniya, *S.* (*Sterculiaceae.*) Shrub or small tree, with hazel-like leaves, common in Trop. Asia. Inner bark affords tough fibre.

Rozelle Fibre (*Hibiscus Sabdariffa*, var. *altissima*).

Hibiscus cannabinus. Deccan-, Ambari-, or Bombay-hemp; Bimlipatam Jute. Annual shrub, 8–10 ft. high, with prickly stems, native of and cultivated in India, also in Nigeria, etc., for the fibre obtained from the inner bark. Plants grown closely yield about 2 tons of fibre per acre. The fibre is of commercial value and exported from Bombay. **H. elatus.** Cuba-bast, Mountain Mahoe. Moderate-sized quick-growing tree of the W. Indies. Useful fibre obtained from inner bark. **H. tiliaceus.** Beli-patta, *S.* A large shrub or small tree, common at low elevations, chiefly near seacoasts, in the tropics. Yields strong fibre, used for ropes, cordage, etc.

H. Sabdariffa, var. altissima. Rozelle Hemp; "Rama" (W. Trop. Africa).—A quick-growing, annual shrub, yielding a strong, jute-like fibre from inner bark of stems (see *Trop. Fruits*). This variety has erect stems, reaching a height of 10–12 ft. or more. The crop prefers flat or undulating land and deep loamy soil.

Seed may be sown in drills, about 12 × 18 in., at the rate of about 12 lb. per acre. Close spacing ensures straight erect stems, which yield the best fibre. The crop should be ready for cutting about 5–6 months from sowing, and a yield per acre of 1 to 1½ tons of prepared fibre should be obtained. Retting takes about 8–10 days, and the fibre is afterwards cleaned by hand, then dried and bleached in the sun, after which it is made up into bales for export. The fibre was quoted in London in 1925 at about £20 per ton for "uncombed," and £30 for "combed" grades.

Honckenya ficifolia. Bolo-bolo, Napunti, Potepo. (*Tiliaceae.*) Annual shrub of Trop. Africa. Stems yield excellent fibre known locally by these names.

Kitul Fibre. Similar to Piassava (*q.v.*). A black bristle-fibre, 2–2½ ft. long, obtained from the leaf bases of *Caryota urens*, the Toddy-, Kitul-, or Jaggery-palm. Kitul fibre was exported from Ceylon in 1929 to the extent of over 1,500 cwt., valued at the equivalent of about 45*s.* per cwt.

Lagetta lintearia. Lace-bark Tree; Lagetto. (*Thymelaeaceae.*) Small slow-growing tree of Jamaica. The inner bark consists of concentric layers of fine interlacing fibres, resembling lace; used for ornaments, etc.

Lasiosiphon eriocephalus. Naha, *S.* (*Thymelaeaceae.*) Bushy shrub of Ceylon and S. India, 6–8 ft. high; inner bark yields good fibre.

Bowstring Hemp.
1, *Sansevieria guineensis*; 2 & 4, *S. zeylanica*; 3, *S. cylindrica*.

Luffa aegyptiaca. Loofah or Sponge Gourd. (*Cucurbitaceae.*) An annual gourd the oblong fruit of which when retted in water yields a network of fibre, commonly used for bath- or vegetable-sponges. Produced largely in Japan for export.

Palmyra Fibre. Strong, wiry, black bristle-fibre, similar to kitul-fibre, obtained from the butt ends of the leaves of *Borassus flabellifer* (Palmyra Palm). Formerly largely exported from Ceylon and valued at about 45*s.* per cwt. The fibre is usually made up into small bundles about 9–12 in. in length.

Pandanus utilis. Screw-pine; Vacoa or Bacoa. A shrubby plant of Mauritius, Madagascar, etc., commonly grown along boundaries of sugar-fields. Leaves woven into mat-bags and largely used for lining sugar-sacks for export, these being afterwards used as fish-bags, etc. They are also employed locally for thatching. Young leaves of this and other spp. are used in Philippines for making fine Manila-hats.

Phoenix zeylanica. Ceylon Date-palm; Indi, *S.* The young leaves, being bleached by dipping for about 15 minutes in boiling water, are made into hats, fancy baskets, etc. in Ceylon.

Piassava; Bast-, Bass-, or Dass-fibre. The commercial term for the long, wiry, flexible bristle-fibre, brown or black in colour, obtained from the leaf-bases of certain palms and used in the manufacture of brooms, whisks and brushes. Bahia Piassava is obtained from *Attalea funifera*, Para Piassava from *Leopoldinia Piassava*, both Brazilian species. Madagascar Piassava is from *Dictyosperma fibrosum*, and W African Piassava from *Raphia vinifera* (Wine-palm) and *R. Hookeri*. The market price of piassava in 1929 ranged, according to quality, from £30 to £38 per ton for "Bahia," and from £28 to £32 for "African." The principal sources are Brazil and Liberia.

Pueraria thunbergiana. Ko-hemp; Kudzu. (*Leguminosae.*) Useful fibre obtained from stems; cultivated in China and Japan. (See *Green Manures.*)

Raffia-tape or bass. A well-known material used for tying purposes and for mats, baskets, etc., is derived from the cuticle of the leaves of *Raphia Ruffia*, a handsome palm of Madagascar with very large, arching, feathery leaves, 22–25 ft. long, and enormous spadices 10–15 ft. long. Raffia is largely exported from Madagascar, and retailed in England at about 3*s.*–4*s.* per lb.

Sansevieria- or Bowstring-Hemp; Niyanda, *S*; Maral, *T.* (*Sansevieria zeylanica.* Haemodoraceae.)—A herbaceous plant with succulent, rigid, concave or furrowed leaves, blotched and mottled with grey, 4–5 ft. high, native of Ceylon, India, etc. It is naturally found in dry or rocky soil at low elevations, but thrives also in a moist climate up to 2,000 ft. or higher, and is readily propagated by seed, suckers or leaf-cuttings. Planted in rows about 2 × 1 ft., it takes 2–3 years to become fit for harvesting. When in full bearing it is estimated to yield about 1 ton or more fibre per acre. The silky white, tough fibre is used for weaving into fine mats, twine, etc., and by natives for bowstrings. It was valued in London in 1925 at £30 per ton. **S. cylindrica.** Trop. Africa. Ife Hemp. Cylindrical, erect leaves, 4–5 ft. long; propagated by suckers or seeds. Yields fine, white fibre. **S. Ehrenbergii.** Somaliland, in arid districts; leaves yield good fibre. **S. guineensis.** Konje Hemp; Sword-plant. Trop. Africa. Leaves flat, sword-shaped, 3–5 ft. long by 3–4 in. broad, banded and blotched with grey. Thrives in arid or moist shady places. Yields fine, white fibre, used for ropes and mats. **S. Roxburghii.** Murva- or Moorva-fibre. From the upright fleshy leaves is obtained a white fibre, used in India for fine mats, hats, etc.

Sesbania aculeata. Dhanicha or Dhunchi. Erect annual. Strong and durable fibre obtained from stems, used for ropes and cordage.

Sida rhombifolia. Kotikan-bevila, *S*; Chittamadi, *T.* (*Malvaceae.*) Erect shrub, common in most trop. countries; stems afford good fibre. **S. tiliaefolia.** Cultivated in China; excellent fibre obtained from stems.

Sorghum Fibre or **Broom Corn.** (*Sorghum vulgare var.* Gramineae.)—A variety of Dhurra or Kaffir-corn, cultivated in some warm temperate countries, as in the U. States, Italy, etc. for its large panicles of grain-heads which, being cut while green, are largely employed for carpet brooms and whisk brushes. The "fibre" should be not less than 15 in. in length, and must not be coarse or brittle. Average yield about 7–10 cwt. of clean fibre per acre. Sowing is at the rate of about 6 lb. of seed per acre, the seed being sown in rows 3 ft. apart. A crop is obtained in 4–5 months, the "fibre" being dried in the shade and afterwards graded. It is usually valued at about £20 per ton.

Sterculia Balanghas. Nawa, *S.* (*Sterculiaceae.*) Small tree of Ceylon, India and Malaya. Inner bark yields strong fibre, used for cordage, etc.

Tampico Hemp. Istle Fibre. (*Agave heteracantha.*) A large succulent, stemless plant of Mexico, yielding a fibre resembling Yucatan Hemp (*q.v.*).

Touchardia latifolia. Olona. (*Urticaceae.*) Shrub of Hawaii; yields fibre used for fishing-nets, etc.

Trachycarpus excelsus. Chinese-coir or Hemp-palm. Small sub-tropical palm of S. China. Coarse fibre from leaf-sheaths used for brushes, etc.

Triumfetta rhomboidea. Epala, *S.* (*Tiliaceae.*) Common shrubby perennial or annual, 5–6 ft. high; yields useful fibre from inner bark, used for ropes, etc.

Urena lobata. Aramina-fibre (Brazil); Patu-epala, *S.* (*Malvaceae.*) Large, erect shrub, common in tropics; stems yield jute-like fibre, used for cordage, etc. Cultivated in Madagascar, Cuba and Brazil, being used for coffee-bags, etc.

Vegetable Hair. A kind of curled fibre, much used for stuffing in upholstery, is obtained from the stem of *Chamaerops humilis*, a dwarf fan-palm of N. Africa. Large quantities are exported annually from Algeria, being usually quoted in England at from £5 to £6 per ton for "green," and £7–£8 for "black" fibre.

Villebrunia integrifolia. Wild- or Ban-Rhea. (*Urticaceae.*) Small shrubby tree, found at medium to high elevations in forests of Ceylon, Bengal, Burma, Malaya, etc. Strong fibre obtained from stems used for coarse ropes, etc.

Wissadula zeylanica. Kiri-kaju, *S.* (*Malvaceae.*) Erect shrubby plant, 5–6 ft. high, common in low-country of Ceylon and tropics generally. Strong fibre obtained from stems.

Zapupe Fibre is obtained in Mexico from several species of *Agave*, of which the most important is *A. Zapupe*, resembling Sisal Hemp. It is claimed to be superior to, and to yield a crop earlier than, Sisal. An average annual yield of about 2½ lb. of fibre per plant is said to be obtained annually, in 3 cuttings. Valued in England in 1928 at about £30 per ton.

PITH-PLANTS, OLAS, ETC.

Aeschynomene aspera. Pith-plant; Shola; Maha-diya-siyambala, *S.* (*Leguminosae.*)—Aquatic or marsh shrub of Ceylon, India, Malaya, etc., common near seacoast. Stems spongy, upright or floating, 2–3 in. diameter. Cut into slices, they are largely used in India for making pith-hats or topees.

Anona palustris. Pith-tree; Cork-wood; Pond-apple; Alligator-apple. (*Anonaceae.*)—A small tree inhabiting swampy land in Trop. America and W. Indies. Wood light and pithy, used for floats, corks, etc.

Borassus flabellifer. Palmyra Palm (*q.v.*).—The young fan-shaped leaves are made into olas (see *Glossary*), which are used for writing on with an iron stylus.

Cecropia peltata. Trumpet-Tree. (*Urticaceae.*)—Small or medium-sized tree of Trop. America and W. Indies, with large palmate leaves. Hollow shoots used for musical instruments, etc. Inner bark yields coarse fibre. Lvs. used as sandpaper.

Corypha umbraculifera. Tala-gaha, *S*; Talipot Palm. The large fan-shaped leaves are made into olas, being written on with a metal stylus and bound in volumes; also used for umbrellas, thatching, etc. (See *Glossary.*)

Fatsia (Aralia) papyrifera. Rice-paper Plant. (*Araliaceae.*)—Shrub 8–12 ft. high, with large, coarse, palmate leaves, silvery white on under side. The stems, being light and pithy, are made into rice-paper. Native of Formosa, introduced to Ceylon in 1856; now occasionally found naturalised by roadsides up-country, spreading by underground rhizomes. Suited to subtropical conditions. A troublesome weed in some countries.

Herminiera elaphroxylon. Nile Pith-tree; Ambash. (*Leguminosae.*)—Small aquatic or marsh tree of Trop. Africa, with spiny stems. Wood white and spongy, used for floats, etc.; also cut into slices and used for sola or sun-hats.

Ochroma Lagopus (*q.v.*).

Scaevola Koenigii. Takkada, or Taccada Pith. (*Goodenoviaceae.*)—Large shrub, 8–12 ft. high, common on seacoast of Eastern tropics. Wood white and pithy, resembling that of the Rice-paper plant (*Fatsia*).

Sonneratia acida and other spp. Mangrove; Kirilla, *S.* (*Lythraceae.*) Large, spreading shrubs, common by lagoons. Root- and branch-wood soft and pithy, used for corks, entomologists' boxes, etc.

RATTANS OR CANES

The rattans or canes of commerce are the long, slender stems of certain climbing palms, divested of the spiny leaf-sheaths of their pinnate leaves. They consist chiefly of species of *Calamus*, a large genus indigenous mostly to Trop. Asia, producing several stems from the base and climbing or spreading by means of sharp recurved spines, reaching from tree to tree and often attaining a length of 300–400 ft. or more. Rattans (from *rotang*, Malaya) are a product of hot, humid forests, chiefly of Malaya, Ceylon, Borneo, Siam, Philippines and Java, and obtained under licence. The chief port of export is Singapore.

The largest rattans are furnished by the stems of *C. rudentum, C. ornatus, C. palustris* and *C. zeylanicus*, and are used entire, as for cables, tying timber rafts, making bridges, cart-hoods, etc. The smaller canes, as *C. javanicus*, are used for chairs, window-blinds, saddlery, basket-work, mats, etc. Those of medium thickness, as *C. Rotang*, which is of the size of the thumb, are usually split into strips of uniform width and length, the inner pithy portion being removed, leaving the external portion, which is hard, flexible and tough; the outer surface is smooth, silicious and polished. These strips are used extensively for chair bottoms, bags, hats, etc. The finest and most valued rattans are, when entire, of the thickness of the little finger. These fetch locally about 26*s.* per picul.

Rattans are imported into Ceylon from Singapore to some extent, being valued at about 28*s.* per cwt. They are also collected in Ceylon, chiefly in the forests of the drier districts of the E. Province, as a forest produce by licence.

Malacca Canes (walking-sticks) are obtained from the stems of non-climbing *Calamus*, the best of which is *C. scipionum*, on account of its very long internodes, sometimes as much as 5 ft. *C. bacularis*, also a non-climbing species, is similarly employed and is valued for tool handles, fishing-rods, etc.

SERICULTURE

The silk of commerce, as is well known, is obtained from the cocoons formed by the "worms" (caterpillars) of certain moths, which in some countries, as in China, Japan, India, parts of S. Europe, etc., are raised in great numbers from "seed" (eggs). The worms are reared in light, airy sheds, on tiers of trays, and fed on the leaves of certain plants which they eat voraciously. There are numerous species or varieties of silk-producing worms, among the best known being: (1) "Mulberry" silk-worm (*Bombyx mori*), which feeds chiefly on the Mulberry leaves and is suited mostly to warm temperate countries; (2) "Eri" (*Attacus ricini*), a multivoltine worm (*i.e.* it undergoes from 6–8 generations in a year) which feeds on the Castor-oil plant and is adapted to the tropics; and (3) the Indian "Tasar" or "Tussar" (*Antherea paphia*), a bivoltine worm (yields 2 crops or generations a year) which feeds on various plants, as species of Cassia, Zizyphus, Lagerstroemia, Eugenia, Terminalia, etc.

The Chinese "Tasar" (*Anthereae pernyi*) is bivoltine and feeds on species of Oak. The worm of the "Atlas-moth" (*Attacus atlas*), which is common in Ceylon, also produces a good second-rate silk and is omnivorous. The "Mulberry" kind produces the finest silk, and is reared extensively in certain temperate countries as well as in India. Of this there are numerous varieties, all of which are univoltine (*i.e.* one generation in the year). The Eri and Indian Tasar worms are especially valued in India, while the Chinese Tasar is largely reared in China.

The silk-moth lays its eggs on a leaf or twig, to which they adhere by means of a gummy substance. The number of eggs laid by each moth varies from 250 to 600 or more, according to species or variety. These are hatched out on large trays of hessian, arranged as already stated. The caterpillars resulting are voracious feeders and require to be fed twice daily with leaves of trees on which they naturally feed. In 2–4 weeks, according to climate and variety of worm, they begin to spin. Before commencing to spin, they fast for 2 or 3 days, void their excrements, become soft and flaccid, and then proceed to construct their cocoons.

The spinning of the latter occupies from 3–5 days. The length of the silk-thread in a cocoon varies according to kind from 900 to 1,500 yds. or more, and cocoons weigh at the rate of about 200–300 or more to the pound, according to size, variety, etc. The process of spinning is effected by passing the thread through two small holes (spinnerets) in the head of the worm, which by a combined movement of the mouth and front legs unites the filament into one, binding it closely together by a gummy liquid. The cocoon finished, the worm undergoes metamorphosis, *i.e.* changes into the chrysalis or pupa state. In about 3 weeks, in the tropics, the moth under normal conditions emerges by forcing its way through the cocoon. The males appear first, then the females, the former being the more active in their movements; they proceed at once to pair, and both usually live but 4 or 5 days, the females meantime laying their eggs, thus completing the life-cycle.

In silk culture, however, the moth is not usually permitted to emerge from the cocoon, as in doing so the latter is seriously damaged, both by the act of piercing and by the dirt and stain left behind. Therefore to obviate this the pupae are destroyed by heating the cocoons in an oven or by steaming. Indispensable conditions for successful sericulture are cheap labour and a plentiful supply of suitable food for the worms. In Italy, Japan, China and other silk-producing countries, it is essentially a cottage industry. Efforts have been made from time to time to establish sericulture as an industry in Ceylon, it being considered an occupation adapted to the peasants, but these have hitherto failed, due partly to the necessity for "destroying life" in the cocoons, which constitutes an offence against the Buddhist religion.

Yield. Both the Mulberry (*Morus indicus*) and Castor-oil plant (*Ricinus communis*) flourish in the tropics at various elevations, the former being readily propagated by cuttings, and the latter from seed and often found in a wild state. Planted at about 4 × 5 ft., an acre should furnish sufficient food for about 600,000 worms. The Eri worm will produce six generations of 100,000 each in a year. Each of these, allowing for deaths, will furnish about 450,000 cocoons, which should weigh about 300 lb. In 1928 these realised 3*s.*–4*s.* or more per lb., or about £45–£50 per acre. The value of the cocoons depends largely on colour, "whites" being generally preferred. Italian silk is the highest priced in the European market, the cocoons being sometimes worth as much as 18*s.* or more per lb.

CHAPTER XXX

DYES AND TANS

(1) *PRINCIPAL DYE PLANTS.* (3) *PRINCIPAL TANS.*
(2) *OTHER DYE PLANTS.* (4) *OTHER VEGETABLE TANS.*

MOST vegetable dyes are now superseded by artificial dyes, as aniline, alizarine, and other products of coal-tar, etc., but certain kinds are still of some commercial importance and are generally considered more permanent than the latter. Vegetable dye-stuffs owe their origin to the presence of small quantities of certain chemical substances secreted in the plant tissues which are extracted by processes of fermentation, boiling, or chemical treatment. Tannin, closely related to dye-stuffs, often occurs in plants as an excretum in the bark and other parts, which are either employed direct, or used for the extraction of the substance in a concentrated form. Tan-stuffs are also often used for dyeing or staining as well as for tanning purposes.

ANNATTO (*Bixa Orellana*).
A.—Section of capsule showing dye-coated seeds.

DYES

Annatto or **Arnatto**; Roucou. (*Bixa Orellana*. Bixaceae.)—A large, quick-growing shrub or small tree with cordate leaves, native of Trop. America, naturalised in parts of W. Trop. Africa; thrives from sea-level to about 2,000 ft. in a moist climate, and prefers a deep loamy soil. It bears at the ends of the branches large clusters of brown or dark-crimson, capsular, ovoid or round fruits with fleshy spines; these contain a number of small seeds, the bright crimson covering of which affords the annatto dye of commerce. The fruits are collected when nearly ripe, and as the shells dry they burst open, the seeds being then either pressed and made into "annatto paste," or merely dried with their covering and then marketed as "annatto seed." Formerly the paste form was preferred by manufacturers, but the demand for this has now declined in favour of the dried "seed." The dye, however, is very fugitive.

Annatto seed is exported from Trop. America, chiefly to the United States and England, and commands about 1*s*. per lb. In Ceylon, small plantations of Annatto were made about 1890–95, chiefly in the Matale district, and the product was until recently an article of export. It has now, however, disappeared from the Island's exports, but the dye is sometimes used locally by the peasants, as for colouring cacao beans. The tree is readily propagated from seed, and the plants may be spaced 18 × 15 ft. A small crop may be obtained after the third year from planting, the yield from mature trees being about 5 cwt. seed per acre. Two or more varieties occur in Ceylon.

Cochineal consists of the dried bodies of woolly insects, commonly known as "bugs" (*Coccus cacti*), which live on species of *Opuntia* or *Nopalea*, chiefly *N. coccinellifera* or Spineless Cactus (*q.v.*). The insect occurs in two varieties, viz. "silver cochineal," which has a greyish-red colour, the furrows of the insect body being covered with a white down; and "black cochineal," which is of a dark reddish-brown and is destitute of down. The former is the more valuable. The male insect is winged, but the female is wingless and when full-grown is of the size of a rice grain. It is the latter which forms the cochineal of commerce, to produce a pound of which some 70,000 insects are required.

The insects are gathered three times a year; they are carefully brushed from the Cactus into bags, killed by immersion in boiling water, and then dried in the sun or over a fire. The dried insects keep in good condition for many years. Cochineal was formerly of considerable importance, being valued for dyeing silk and for colouring butter and cheese. It produces beautiful scarlet shades, but is now mostly superseded by aniline dyes, its chief use being for artists' paints. Originally a Mexican industry, it has been introduced into Brazil, Java, Canary Islands, etc., the last-mentioned country still doing a considerable trade in it. Europe alone takes some 1½ million pounds of cochineal annually, the price ranging about 3*s*. per lb. Formerly it fetched from 6*s*. to 9*s*. per lb.

Cutch or **Catechu**; Khair or Katha of India. (*Acacia Catechu*.) A medium-sized tree, common in parts of India, Burma, etc. A black gum-resin known as Cutch or Catechu, obtained by boiling chips of the heart-wood, is astringent and extensively employed for dyeing and tanning, being largely exported. It is estimated one ton of the heart-wood yields on an average 250 to 300 lb. of cutch. A form of cutch is commonly used in India for chewing with "betel" leaf (*q.v.*), and a valuable gum, resembling gum arabic, is also obtained from it, while the wood is one of the best for charcoal. The term "cutch" is applied to a similar extract from Gambier (*q.v.*).

Dragon's Blood. A resinous incrustation obtained from the scaly covering of the fruits of *Daemonorops propinquus*, a climbing palm of the Rattan family (*q.v.*), collected chiefly in Borneo, Sumatra, Malaya, etc. The small, round fruits, about ¾ in. diam., are dried, then shaken in a basket, through which the resin falls; it is collected on a cloth damped in hot water, and pressed into moulds. "Singapore Lump" dragon's blood is now quoted at about £27 per cwt. Similar substances, known by the name of Dragon's Blood, are obtained from *Dracaena Draco* in the Canary Islands, *Dracaena Cinnabari* in Socotra and Zanzibar, and *Croton Draco* in Mexico. The chief use of the product is for colouring varnishes.

Henna; Tree Mignonette; Marithondi, *T*. (*Lawsonia inermis*. Lythraceae.) A shrub 6–8 ft. high, widely distributed in the drier parts of N. and E. Tropical Africa, Madagascar, Trop. Asia (including Ceylon) and Australia. It is often cultivated in hedges and as a dye plant, especially in India, Persia, Egypt, etc. The small oval leaves, powdered and made into a paste, give the Henna dye, which is commonly used, especially by Mohammedans, for dyeing the hair, nails, beard and skin a dull orange-yellow. The leaves are exported to Europe for use in cosmetics and similar purposes. At each clipping of the plants, about 8 or 9 in. are taken off the young shoots, the annual yield being about 1,600 lb. of dried leaves, etc., per

acre. In Europe, Henna is often mixed with the flower-heads of Chamomile (*Anthemis nobilis*). Indian henna leaves now quoted in London at 45*s.* per cwt.

Indigo. Nil-awari, *S.* A blue dye obtained from species of *Indigofera* (Leguminosae), chiefly *I. arrecta* and *I. sumatrana*, shrubby perennials, but cultivated as annuals, 3–6 ft. high. *I. tinctoria*, formerly extensively grown for the dye, has been superseded by the former, which are known as the "Natal"- or "Java"-indigo, owing to their heavier yield and higher *indigotin* content. The only producing countries, if any, are India and Java. Once a flourishing industry, it has now been practically ousted from the market by the aniline dyes, first introduced in 1880. During the Great War, however, indigo received a fresh impetus, the price advancing in one year from £17 to £67. This and other vegetable dyes are, however, considered to have certain advantages over aniline dyes, being "softer" and more permanent, *e.g.*, the famous Persian rugs and carpets in which natural dyes are used.

Cultivation. The plant requires a hot and moist climate (rainfall not under 70–80 in.) and well-drained, light friable soil. Thorough tillage is necessary. The seed is sown in lines about 2 ft. apart, 12–15 lb. being required to the acre. The seed germinates in 3 or 4 days, and about 3 months later the flowers appear, when the plants are ready for harvesting. The crop is usually cut down to within about 6 in. from the ground, tied up in bundles, and carried fresh to the factory. The stumps left in the ground will afterwards "rattoon," and two, or in favourable conditions as many as four, rattoon crops may be obtained from the same roots within the year. The plant is best grown in rotation with other crops.

To produce the dye, the green crop is placed in large masonry tanks and weighted down with planks. Water is laid on so as to cover the whole, which is subjected to a process of fermentation and churning. Fermentation is allowed to go on for 12–16 hrs., and stopped when the leaves become a pale colour. The liquid is run off by means of a tap at the bottom of the tank, into a second tank or cistern, and is kept constantly agitated by either wading coolies beating with paddles, or by a mechanical contrivance, for 2 or 3 hrs., after which the indigo settles in the bottom in the form of bluish mud. This, after draining off the water, is put into bags which are hung to dry, being afterwards cut into cubes about 3 in. square, stamped, and further dried for export.

Yield. A good yield should be about 12,000 lb. of green crop per acre from the first cutting, giving 60 lb. dry indigo. Subsequent or rattoon crops give smaller yields. About 35–40 lb. of indigo-paste may be obtained from 1,000 lb. of green plant, and 500 lb. of paste per acre is considered a good average annual yield. Normally, indigo fetches about 2*s.* 6*d.*–3*s.* 3*d.* per lb. in England.

Chinese Indigo is obtained from *Polygonum tinctorium*, a large herbaceous perennial, commonly cultivated in China and Japan, and known in Corea as "Tjok." **Yoruba Indigo,** see *Lonchocarpus.*

Logwood. (*Haematoxylon campechianum.* Leguminosae.) A small, slow-growing tree, about 20 ft. high, native of Cent. America, introduced and naturalised in Jamaica and other W. Indian islands. The heartwood as well as the roots are exported for the extraction of a valuable fast dye (black, dark-blue, or purple), which is used in the manufacture of ink and in dyeing woollen and silk goods, and for numerous other purposes. Introduced to Ceylon in 1845.

The tree thrives naturally in a hot and rather dry climate, a moist atmosphere and rich, heavy soil being unfavourable to the development of the dye. In cultivation, care should be taken to select the red-wood kind, the "bastard" or colourless sort being of no value. Propagation is by seed. Seedlings may be planted out 12 × 12 ft. apart, or about 300 to the acre. Little attention is necessary, beyond weeding, after the plants are well established. From the age of 10–12 years the trees are ready for felling; the sap-wood, being valueless, is chipped off and discarded, and the brownish-red heartwood is made up in bales for export, being usually valued at about £3–£6 per ton, and the roots about £2. In Jamaica it is used to some extent for the extraction of the dye locally. British Honduras, where the tree is indigenous, is the principal exporting country.

Orchella. (*Rocella Montaguei.*) A pale, greenish-grey lichen, with flaccid, ribbon-like fronds, found growing on rocks or old tree-trunks, chiefly in drier districts close to the sea-coast. The lichen was formerly collected in Ceylon and, being dried and made up in bales, exported for the purpose of extracting the dyes litmus, orchil, etc. It was valued at about 15*s.*–20*s.* per cwt.

Saffron. (*Crocus sativus.* Irideae.) Small, showy bulbous plant of the Iris family, 6–10 in. high, native of S. Europe, cultivated in Spain, S. France, Turkey, Persia, Kashmir and China for the sake of the orange-coloured stigmas of the flowers. From these the true saffron of commerce, used as a colouring agent, is obtained. This is employed in India chiefly for princely marriages and for caste markings of the wealthy. Its cultivation dates back to remote antiquity, and at one time was much used in medicine. It requires a warm or sub-tropical climate and a rich, well-drained garden soil. It is propagated from bulbs (corms), which when once established may be left in the ground undisturbed for 10–15 years or more. During the blossoming period (October–December in Kashmir) the flowers are collected daily, just as they open. The stigmas are then removed by hand and dried immediately, usually in a fine sieve over a low fire. When fully dried, they are at once packed or stored. The yield is variously estimated at from 10 to 30 lb. per acre. About 40,000 flowers are required to produce a pound of dry saffron, which consequently is very expensive, being valued at from about £6–£7 per lb.

SAPPAN-WOOD (*Caesalpinia Sappan*). Showing (1) pods, (2) flowers, (3) section of wood, and (4) pod with seeds exposed. Note large proportion of dye-wood.

Safflower, or **False Saffron;** Kasum or Kurdi of India. (*Carthamus tinctorius.* Compositae.) A prickly, herbaceous plant, 2–4 ft. high, supposed to be indigenous to India; cultivated in Egypt, China, India, Persia, Spain, etc., for the orange-yellow florets of the aster-like flowers, which are used as a dye. These are collected fresh in the morning, dried in the shade on muslin trays, and afterwards stored in tins. In India the crop is sown in October or November and harvested in January–April. It thrives in a light, well-tilled, sandy soil. Seed is sown broadcast or in drills (spacing about 18 × 22 in.) at the rate of about 6 lb. to the acre. The yield of florets should be about 80 lb. per acre. The red colouring-matter (*carthamin*) is valued for dyeing silk, cotton, etc. Safflower was at one time largely exported from N. India and Persia to Europe. The chief use of the plant now is for the oil from the seed, esteemed for cooking, etc. Yield of seed per acre about 500 lb. or 10 bushels.

Sappan-wood. Bakam, Tairi, or Patang of India; Pattangi, *S.* (*Caesalpinia Sappan.* Leguminosae.) A large, straggling, prickly, semi-climbing shrub, native of India and Malaya, naturalised in the moist low-country of Ceylon. The dark-red heartwood yields a red dye and is exported, chiefly from Siam and the Philippines, after removal of the sapwood, for the extraction of the dye.

Some 900 cwt. of sappan-wood is exported from Ceylon annually, valued at about 9*s.* per cwt. The dye is used for dyeing wool, calico, etc. The plant grows in clumps, producing several stems, which take about 6 years or more to produce a marketable heartwood, and requires no cultivation. As the older stems are removed, others grow up and take their place. Seed season, August–November. The plant, woven by itself or between trees, forms a good barrier hedge. It was once known as Brazil Wood, which properly belongs to *C. echinata* of S. America, on account of which the country Brazil takes its name.

OTHER DYE PLANTS

Artocarpus integrifolia. Jak; Kos, *S*; Kanthal of India. A large tree of India, etc. The heartwood yields a yellow dye, used for dyeing mats, priests' robes, etc. The young shoots, on being cut, yield a quantity of white sticky latex. (See *Tropical Fruits.*)

Baphia nitida. Camwood. A large leguminous tree of W. Trop. Africa. The red heartwood yields a bright red dye and is exported, chiefly to the U. States; it is valued at from £5 to £8 per ton in London.

Butea frondosa. Palas or Pulas. Flowers used in India to produce a yellow or orange-red dye. (See *Flowering Trees*, etc.)

Curcuma domestica (= *C. longa*). Turmeric. The dried rhizomes yield the yellow dye turmeric. (See *Spices.*)

Chlorophora tinctoria. Fustic. (*Rubiaceae.*) A large tree of Cent. America. Heartwood yields yellow or orange dye, which was much employed during the War for dyeing khaki cloth, being obtained chiefly from Jamaica and Trinidad.

Cosmos sulphureus. Xochipalli. (*Compositae.*) Ornamental annual (*q.v.*) of Mexico. The bright orange-yellow flowers yield an orange-red dye.

Garcinia Xanthochymus. Cochin- or Rata-goraka, *S*. Small, bushy, conical tree. Yellow dye obtained from bark is commonly employed in Assam for dyeing cloth, etc. (See *Trop. Fruits.*)

Hibiscus rosa-sinensis. Shoe-flower; Sapatthu-mal, *S*. Tall shrub, occurring in many varieties. Flowers afford a red dye; commonly used locally for colouring in cookery, etc. (See *Flowering Shrubs.*)

Lonchocarpus cyanescens. Yoruba Indigo. (*Leguminosae.*) Large climber with fine, pinnate leaves, native of W. Trop. Africa. A blue colouring-matter, extracted from the young leaves, used in Nigeria for dyeing native cloth.

Mallotus philippinensis. Hamparila, *S*; Kapila, *T*. (*Euphorbiaceae.*) A moderate-sized tree of Ceylon, India, Malaya, etc. The glandular pubescence of the fruit yields a rich orange-red permanent dye known as Kamala-dye.

Memecylon capitellatum. Weli-kaha or Dodan-kaha, *S*; Katti-kaya, *T*. (*Melastomaceae.*) Ceylon shrub, 6–8 ft. high. Leaves afford a yellow or brown dye used for colouring mats. (See *Flowering Shrubs.*)

Nyctanthes Arbor-tristis. Night-flowering Jasmine; Sepalika, *S* (*q.v.*). Large shrub of Cent. India. Flowers yield a yellow dye, used for dyeing cotton cloth, etc., and as a cheap substitute for saffron.

Oldenlandia (Hedyotis) umbellata. Indian Madder; Chaya-root; Saya, *S*; Chaya, *T*. (*Rubiaceae.*) Small annual, 10–12 in. high, found by sea-coast (chiefly in drier regions) in India, Ceylon, etc. Roots afford a pinkish-purple dye. Formerly collected under Government licence and exported.

Pterocarpus santalinus. Red-sanders; Red Sandal-wood. A medium-sized tree of India, the red heartwood of which is fragrant and resembles Sandal-wood. It affords a reddish-brown dye used for colouring woollen fabrics. Cultivated in Bengal and elsewhere in India.

Rhus Cotinus. Venetian Sumach; Young Fustic. (*Anacardiaceae.*) Small tree of S. Europe. Young twigs yield a bright-yellow dye. (See *Tans.*)

Rubia tinctorum. Madder. (*Rubiaceae.*) Herbaceous perennial climber, formerly largely cultivated in S. Europe, N. India, etc., for the dye (alizarin) obtained from the roots.

Semecarpus Anacardium. Marking-nut; Sen-kotta. (*Anacardiaceae.*) Moderate-sized deciduous tree of India, Malay, etc. Juice of nut, mixed with quick-lime, forms indelible ink used for marking linen.

TANS

Divi-Divi; Livi-divi; Vanni, *T*. (*Caesalpinia coriaria.* Leguminosae.) A small, spreading tree, 25–30 ft. high, with small bipinnate leaves and greenish-white, sweet-scented flowers, native of Cent. America; first introduced into India about 1834, and into Ceylon probably about the same time. The tree is adapted to a rather dry climate, and thrives up to about 2,000 feet; sometimes found in a cultivated state in Resthouse compounds and elsewhere in Ceylon. The pods are rich in tannin and largely exported from Venezuela and the Island of Curacao. The exports from India, in parts of which the tree has become acclimatised, dropped from about 400 tons in 1914 to 150 tons in 1918, being valued at about £8 to £10 per ton.

Propagation is by seed sown in a shaded bed, the seedlings being afterwards transplanted into bamboo joints, from which they are finally planted out. Spacing may at first be about 15 ft. each way, which may later, if necessary, be increased by thinning out the weaker trees to about 100 to the acre. Or they may be planted at wide spacing as shade and catch-crop, the tree being suitable as permanent shade for certain crops at low elevations.

Yield. The trees usually begin to bear when 6–8 years old, and at the age of 10–12 years should produce from 30 to 40 lb. of dry pods each, increasing to 60 or 80 lb. each, or about 2 tons per acre when in full bearing. The pods, which are in season in Ceylon chiefly during December–February, are picked when fully ripe, *i.e.* when the seed can be heard to rattle inside. The crop is a precarious one, and the demand for the product is apparently uncertain. (See *Avenue Trees.*)

DIVI-DIVI (*Caesalpinia coriaria*).
Showing brown, twisted pods, valued as a tanning material.

Gambier or **Gambir**; **Terra Japonica.** (*Uncaria Gambier.* Rubiaceae.) A Malayan climbing shrub from which a black, tar-like resinous, gummy substance (gambier), similar to cutch, is extracted by boiling chips of the wood as well as the young shoots and leaves.

Gambier is a dyeing and tanning material. It is very astringent and is employed in medicine, and in Malaya for chewing with the betel-leaf, etc. It is a "forest produce," and is largely exported from Malaya, being valued in England, according to quality, at from 50*s.* for "blocks," to about 80*s.* per cwt. for "cubes." The plant, introduced to Ceylon in 1887, flourishes in the moist climate of Henaratgoda Gardens, near sea-level, but is unsuited for cultivation above 1,500 ft. elevation. The product is obtained chiefly from Johore.

Quebracho; Break-axe Tree. (*Schinopsis Lorentzii.* Anacardiaceae.) A large, very hard-wooded tree of Paraguay, etc. The heartwood, reduced to chips and boiled, yields a cutch-like substance, largely exported to Europe, U. States, etc., for tanning purposes, Britain alone taking over 100,000 tons a year from the Argentine.

Wattle Bark. The bark of several species of Australian *Acacia* is rich in tannin and extensively used in commerce, the most important being Black-wattle (*Acacia decurrens* var. *mollissima*), Silver-wattle (*A. dealbata*), Black-wood (*A. melanoxylon*), and Golden- or Broad-leaved wattle (*A. pycnantha*). See *Shade and Windbreak Trees*. These and other species have become thoroughly established at elevations of 5,000–6,000 ft. in India and Ceylon, thriving on poor patana land. They have also been introduced and naturalised in S. Africa and other warm countries, and in Natal are cultivated extensively for the export of the bark. The latter is the largest exporting country, some 20,000 tons being thus disposed of annually.

Propagation is by seed, 3 or 4 of which being placed together "at stake," or in bamboo- or reed-joints. The former method is preferable when planting on a large scale. As the outer coating of the seed is very hard, the seed should be placed in almost boiling water and left to soak for 2 or 3 days before sowing. If the seed can then be cut with the thumb-nail, it is soft enough for sowing; otherwise pour more hot water over it, and leave to soak longer. About 30,000 seeds usually go to a pound, and from 1 to 1½ lb. of seed should be allowed per acre.

Cultivation. The trees grow readily in almost any well-drained soil, under sub-tropical conditions, or at medium to high elevations in the tropics. They make excellent wind-breaks, especially *A. dealbata*, which suckers or coppices freely, and may be planted for this purpose about 8 × 8 ft. Planted for the bark, a spacing of 6 × 6 ft. (= 1,210 trees to the acre) is recommended in Natal. This allows for thinning out when the trees are about 4 years old. The trees grow rapidly, attaining in Ceylon a height of 15–20 ft. or more in 2 years.

Harvesting and Yield. Under favourable conditions the trees should be ready for *barking* at about 7–8 years of age, when the yield should be about 3–4 tons of bark per acre. A small crop may be obtained from thinnings, which should take place when the plantation is 4 or 5 years old, but the bark from young trees is less rich in tannin. The best time to strip is when "the sap is up," *i.e.* when growth is active. The usual method is to clear the stem of small twigs and branches, and *ring* the bark with an axe as high up the tree as a man can reach. A longitudinal cut is then made in the bark from the ring to the bottom, and the bark may be slightly hammered with the back of the axe. The bark can then be easily removed by inserting the axe underneath, pulling it off in strips with a downward jerk. The trees are then felled, the upper branches removed, and the remaining bark stripped. Well-grown trees about 14 years old yield as much as 1 cwt. of dry bark each, and smaller trees from 40 to 50 lb. At Hakgala Gardens, Ceylon, trees 5 years old yielded each over 50 lb. dried bark. In Natal, coolies work mostly on task-work, each stripping about 800 lb. of bark per day. In Australia, the cost of barking varies from £2 10*s*. to £3 per ton. Drying the bark is done in the open air, but open sheds, fitted with horizontal poles on which the bark can be placed in case of rain, are useful. In the open, green bark will dry in about 8 days in fine weather, losing about 30 per cent. of its weight in the process. The bark is then cut up by a machine into small inch-pieces, and afterwards packed with hessian in bales of about 200 lb. each for export.

The bark usually fetches from £9 to £11 per ton in London. In some localities a revenue may be obtained from the sale of stripped trees for poles, timber, fuel, etc. During the first year a catch-crop may be raised between the lines. Replanting may be necessary every eighth or ninth year, after the ground is cleared of all timber and debris.

OTHER SOURCES OF TAN

Acacia arabica; Karuvel, *T*; Babul of India. A small tree, widely distributed in dry districts in India, Ceylon, Africa, etc. The bark is extensively used in India for tanning; also as a dye in calico printing.

A. Catechu. Cutch; Catechu; Black- or Pegu-Catechu. (See *Dyes*, etc.)

Anogeissus latifolia. Dhaura. (*Combretaceae.*) A large deciduous tree of S. and Cent. India, the leaves of which are used for tanning. A gum obtained from the stem is used in calico printing. (See *Gums.*)

Areca Catechu. Arecanut; Puwak, *S*. An erect, slender palm, native of Malaya. Wood and astringent fruit used for tanning. (See *Masticatories.*)

Caesalpinia digyna. Tari Pods, the fruit of a prickly, climbing shrub of India, rich in tannin and used for tanning purposes.

Careya arborea. Patana Oak; Kahata, *S*. A small or medium-sized tree of Ceylon, India, etc. Bark astringent, used for tanning and in medicine.

Cassia auriculata. Ranawara, *S*. Avarai, *T*; Tanner's Cassia; Matara Tea (*q.v.*). A quick-growing large shrub of Ceylon, India, Burma, etc. Bark largely used by tanners. Leaves used in medicine, and young shoots as tooth-brushes.

Casuarina equisetifolia and other species. Bark astringent and sometimes used in tanning.

Diospyros Embryopteris. Timbiri, *S*. Handsome tree of India, Ceylon and Malaya, 40–50 ft. Bark and unripe fruits very astringent, the latter commonly used for tanning fishing-nets, etc., also medicinally in India. Seeds yield Funk Oil.

Mallet Bark. (*Eucalyptus occidentalis*, var. *astringens.*) W. Australian tree. Bark recently come into use for tanning, being rich in tannic matter.

Mangrove Bark. (See *Ceriops* and *Rhizophora.*)

Mimusops hexandra. Palu, *S*; Palai, *T*. Moderate-sized, hard-wooded, slow-growing tree of India and Ceylon. Bark astringent, recommended for tanning; commonly used for retarding fermentation in toddy. (See *Timbers.*)

Phyllanthus Emblica. Emblic Myrobalans; Ambal or Amlika; Nel-li, *S*. Small tree or shrub of Ceylon, India, Java, etc.; common on open patana land at medium elevations in Ceylon. Fruit, bark and leaves used in India for tanning.

Rhizophora mucronata. Mangrove Bark; Kadol, *S*; Kandal, *T*. (*Rhizophoraceae.*) Ceylon and E. Tropics. Moderate-sized spreading tree, inhabiting lagoons of most tropical countries. Bark and extract from wood used for tanning and dyeing. Species of *Ceriops*, another form of Mangrove, are similarly used.

Rhus coriaria. Mediterranean Sumach. Hardy shrub, found on rocky slopes in Sicily, etc.; cultivated for the leaves and shoots, which are used for tanning.

R. Cotinus. Venetian Sumach; Young Fustic. (See *Dyes.*)

Rumex hymenosepalus. Canaigre. (*Polygonaceae.*) A tuberous perennial of Mexico, where the astringent tuberous roots are used for tanning purposes.

Semecarpus Anacardium. Marking-nut Tree. (See *Dyes.*)

Sumach, Cape. (*Colpoon compressum. Santalaceae*); Jamaica Sumach (*Rhus Metopium*); Mediterranean Sumach (*R. coriaria*); Venetian Sumach (*R. Cotinus*).

Terminalia belerica. Beleric Myrobalans; Bulu, *S*; Tanti, *T*. (*Combretaceae.*) A very large deciduous tree of Ceylon, India, Malaya, etc. The dried "nuts" (fruit) are used in India as a dyeing and tanning material, but considered inferior to *T. Chebula*; also employed in native medicine. Kernels edible. Wood of little value except for inferior planking.

T. Chebula. Chebulic or Black Myrobalans; Ink-nuts; Gall-nuts; Aralu, *S*; Kadukkay, *T*. Ceylon, India, Burma, etc. A moderate-sized deciduous tree. Fruit and bark rich in tannin and used largely in India for dyeing and tanning, being regarded as one of the most valuable of Indian tanning materials; they yield a black or yellow dye, and are also valued in medicine. They are collected as a "forest produce," under licence, and largely exported from India, as they were formerly from Ceylon. Like other species of Terminalia, the tree yields a gum, which is collected and used for mixing with other gums. Wood fairly hard and durable.

Vateria acuminata. Hal, *S*. A large, handsome tree of the moist low-country of Ceylon (endemic). Bark astringent, commonly used in Ceylon for retarding fermentation in palm toddy. (See *Gums and Resins.*)

CHAPTER XXXI

PASTURE- AND FODDER-PLANTS

(1) *PASTURE-MAKING.* (2) *FODDER OR HAY GRASSES.* (3) *OTHER FORAGE PLANTS.* (4) *PASTURE PLANTS.* (5) *BROWSE OR FAMINE PLANTS.*

PASTURES IN THE TROPICS

In many parts of the tropics the scarcity of pasture, natural or artificial, for grazing stock is often severely felt. Frequently the natural grasses grow coarse and wiry, woody growths take the place of herbage, while the requisite conditions for good pasturage are often lacking. Thus the cultivation of perennial crops, as is common in the tropics, precludes crop rotation and, therefore, the inclusion of grazing crops in the planting routine. Periods of severe drought, soils often deficient in humus, and the deficiency of natural herbage are factors which accentuate the problem. Here fallow land rapidly becomes occupied with scrub or arborescent growths if not constantly weeded. The extensive grass-covered patana lands occurring at the higher elevations in Ceylon are of little use for grazing, except perhaps for a short period after burning off the old grasses, which consist mainly of *Cymbopogon Nardus*, or Maana-grass, with large, coarse and aromatic leaves. Moreover, in many cases live pests, as ticks, leeches, and in Africa the tsetse fly, are a serious handicap to grazing conditions.

The maintenance of healthy cattle in the tropics is of the utmost importance, for they are often indispensable for draught purposes in addition to their legitimate use for food. Therefore, any measures calculated to provide satisfactory sustenance for them deserve serious attention. In Ceylon, the small indigenous cattle are often allowed to roam and pick up what food they can, while the heavier imported animals are invariably stall-fed and, in many cases, have never learned to graze. Under average conditions, 3 acres of pasture should maintain one cow, while one acre well cultivated with fodder, as Guinea-grass, supplemented with about 3 or 4 lb. of concentrated feeding stuff per day each, should support 3 medium-sized cows. A stall-fed cow of medium size requires 40–45 lb. of green grass a day, whilst a larger animal will need 50–60 lb. a day.

Fodder Catch-crops. The cultivation of special grasses, or suitable leguminous plants, for fodder between certain perennial tree-crops, as on coconut plantations, is sometimes recommended. On mature coconut plantations the ground between the palms may with advantage be put under such crops, or even used for grazing cattle. The manure from the latter will benefit the palms, while the light filtering shade afforded by these favours the growth of tender grasses. Thus in some countries, as in Fiji, cattle are sometimes herded and fed on coconut plantations.

Ravines, Patanas, Jungle Reserve, etc. On plantations there are often ravines, strips of private roadsides, etc., which, though regarded as waste ground, might be utilised for the growth of fodder plants. Uncleared jungle, in many cases, need

only have the tangle of undergrowth removed in order to afford suitable conditions for pasturage. Patanas and abandoned chena land might also, in many cases, be reclaimed and rendered suitable for pasturing, while peasants' compounds, or so-called gardens, could often be much improved by clearing away the useless undergrowth and encouraging the growth of fodder or pasture under the shade of trees, to the advantage of the health of the occupants. Under the seepage of irrigation tanks or reservoirs, there are often considerable areas which might be utilised for grazing purposes or for growing fodder crops.

Fallow Rice-fields, etc. After reaping a harvest of paddy, the goiya (Sinhalese farmer) usually leaves his fields bare for a considerable period, in some cases abandoning them for several years. If these were re-irrigated and planted under leguminous herbaceous plants, they would provide a source of food for cattle during the dry season, besides restoring the fertility of the soil. (See *Green Manuring.*)

Ensilage. In some countries it is customary to make provision for seasons of scarcity by converting surplus grass or other fodder into a form of hay or ensilage. Ensilage has the advantage of preserving fodder in its green nourishing state for a considerable period. The following is the usual mode of procedure: A large round pit, called a silo, sufficient to hold from 30 to 50 tons or more of green forage, is excavated; the grass is cut while soft and moist, just as the ears begin to harden, and placed at once in the silo, pressing it down tightly. When quite full, the top is covered with planks and then earth, making the silo as far as possible light- and air-tight. It should also be protected against rain and surface water.

Formation of Pastures. Any available land, provided the soil is reasonably deep and moist, may be made to answer the purpose of pasture. In order to give the grasses, etc., a good foundation, the ground should be well tilled and broken up before planting, being ploughed deeply or dug to a depth of 15 in. or more, removing large stones, roots, etc., and leaving a tolerably smooth surface.

A certain amount of shade is beneficial, both for the growth of pasture and for affording shelter to stock from the fierce sun. Therefore, existing trees, with the lower branches removed, should be left at suitable distances apart or, where these are wanting, light-foliaged species should be planted, as *Albizzia moluccana*, *A. Lebbek* ("Sirrus"), *Pithecolobium Saman* (Rain Tree), *Erythrina lithosperma*, etc. Grass seed may be sown broadcast at the rate of about 15 or 20 lb. to the acre, and afterwards raked or harrowed into the soil; or roots or cuttings of selected grasses may be planted out in wet weather at distances of about 6 in. apart, the object being to form a close sward in the shortest time possible. The latter method is often the more suited to the tropics, especially where labour is plentiful. (See *Lawns.*)

Upkeep of Pastures. Due attention with regard to manuring, weeding, etc., is necessary for the maintenance of good pasture. Coarse weeds or woody growths are liable to appear, and these if unchecked will soon supersede the desired species. An occasional surface-dressing, consisting of well-decomposed manure mixed with some loamy soil, or an application of a suitable fertiliser, well repays the initial cost.

The following mixture is especially recommended, the quantities being for an acre, viz.: basic slag, 250 lb.; nitrate of soda, 150 lb.; muriate of potash, 100 lb. The mixture may be applied at the rate of 2 or 3 oz. per square yard. Cattle should not be allowed to graze on land so treated for about 2 months after the application. Partial irrigation in dry weather not only greatly increases the yield, but also improves the quality of the feed; in dry regions frequent flooding is necessary.

Fodder or **Forage Grasses,** as distinct from grazing or pasture kinds, are tall-growing, with leafy stems (culms) and tufted habit (cespitose), and suitable for cutting and feeding to stock or forming into hay. They are generally adapted to alluvial, moist or irrigated land, as along river-banks; require good cultivation, occasional manuring, and sufficient moisture in order to afford heavy and regular yields. On steep land, terracing and some irrigation may have to be resorted to. The ground having been well tilled, limed and manured, roots may be planted about 18 × 18 in., as for Guinea-grass, or at less or greater distances according to species and locality, always choosing wet weather for the purpose. On sloping land or shallow soil the spacing may be closer. If the weather should turn

dry, it may be necessary to water the plants, shading them with fern fronds, etc., until well established. The first cutting may be made about 3 months after planting, and subsequent cuttings at intervals of about 3 weeks or a month.

The ground may require weeding once in 2 or 3 months, and should be manured and lightly forked once or twice a year. Cattle manure is the best, for it furnishes humus and mulch, besides plant-food. 10 tons per acre is a liberal application. A dressing of lime at the rate of about 1½–2 tons to the acre may be given, say once in 3 years or oftener, especially if the ground is of a sour or heavy nature. Chopping down the sides of the rows should be done periodically, as at the time of forking or manuring. It is usually best to replant the field once in 3 or 4 years.

The quality of grasses and their food-values depend much on cultivation and locality; certain species are specially suited to dry districts, while others will thrive only in moist land. "English" grasses, it may be said, are seldom a success in the tropics, and even at the higher elevations are soon replaced by local species or weeds.

FODDER OR HAY GRASSES

Andropogon (Sorghum) halapense. Johnson- or Cuba-Grass. A tall, handsome perennial with creeping rhizomes, commonly grown in parts of India, United States, Australia, etc., being esteemed for green fodder or hay, sometimes a bad weed. In India the seed is eaten by the poorer classes. **A. pertusus.** Barbados. Sour Grass. A perennial with rather aromatic leaves, bearded at the nodes, 1½–2 ft. high, common in Ceylon and Trop. Asia generally; naturalised in parts of the W. Indies and said to be the chief fodder grass of Barbados, where it is considered "an excellent fodder in a green or dry state, yielding 5–7 tons annually without manure, and 10–12 tons with manure." It may be cut 3 or 4 times a year, and is readily propagated by roots planted 1 × 1 ft. apart. **A. Sorghum,** var.; Sudan Grass (see *Guinea Corn*). A tall, erect annual with numerous leafy stems, 6–8 ft. high, similar to Johnson Grass. Cultivated for fodder as well as for grain and yields heavy returns. In S. Africa it is said to be "one of the most drought-resisting hay crops." Seed may be sown broadcast at the rate of 20 lb. (or 4–5 lb. if in rows) per acre.

Anthistiria australis (*A. imerbis*). Kangaroo Grass of Australia. A perennial, 2–3 ft. high, common in Ceylon, India, and E. Africa. In parts of Australia it is regarded as one of the most useful of indigenous grasses, stock of all kinds being fond of it, while in E. Africa it is esteemed for green fodder or hay. **A. cymbaria.** Karawata-maana, *S.* Abundant on up-country patanas, Ceylon; often cut and dried for fodder, being "a good substitute for hay" (Ferguson).

Chloris Gayana. Rhodes Grass; Sweet Grass. A dense-growing perennial, about 2 ft. high, much in favour as a fodder grass in S. Africa; suitable for warm or sub-tropical climates. Cultivated in India as pasture for dairy cattle. Thrives at Peradeniya, Ceylon, but apparently is suited to a drier climate.

Coix Lacryma-Jobi. Job's Tears; Kikirindi, *S*; Adlay of the Philippines, etc. (See *Cereals.*)

Cynodon Dactylon. Doob- or Doub-Grass; Bahama Grass; Devil's Grass; Bermuda Grass; Arugam-pillu, *T.* A prostrate or creeping perennial with fine, narrow leaves and slender stems, found in all warm countries, especially in arid regions. Resists drought, makes good hay, and is adapted for covering bare land in dry districts or near the sea. In British Guiana, "a crop in the Botanic Gardens gave a yield of over 20 tons of green fodder per acre from 12 mowings. Under ordinary conditions it may be expected to give at least 10 tons per acre." Easily propagated by cuttings or seed. Forms a good sward (see *Lawns*) and is a favourite lawn-grass in India, Egypt, etc., though a troublesome weed in the S. United States and elsewhere. Not suited to shady or moist situations.

Eragrostis abyssinica. Teff, Jtheff, or Thaff. An Abyssinian annual grass, commonly cultivated in E. and S. Africa, etc., for fodder, also sometimes for its grain. It is valued for dry regions, giving a return of 8 to 10 tons green forage per acre. 8–10 lb. seed will sow an acre.

Euchlaena (Reana) luxurians. Teosinte. A tall, annual, maize-like grass of Guatemala, etc., with large angular grains and large, broad leaves, 6–8 ft. high, sometimes 10–12 ft. or more; one of the most prolific of fodder plants, tillering well and, under favourable conditions, yielding very heavy crops. Cultivated for forage or ensilage. At Madras, under irrigation, a single cutting gave a yield of about 20 tons per acre, while the crop for the year, in 3 or 4 cuttings, was estimated to give 60–80 tons. Cattle and horses are very fond of it. (See *Ornamental Grasses.*)

Ischaemum ciliare. Rat-tana, *S*; Nandu-kanni, *T.* A common perennial, found at all elevations in Ceylon; at one time commonly grown under the shade of coconuts near Colombo and brought into town as fodder for cattle. **I. muticum.** Common in damp situations near Colombo; large quantities, according to Ferguson, used to be collected by the grass-women for horse-food in Colombo. In the jungle, where it naturally obtains support, it grows several feet in height. **I. timorense** (*Spodiopogon obliquivalvis*). A slender, straggling grass, common in the low-country of Ceylon, usually inhabiting damp and shady places; excellent for green fodder. This grass is remarkable for its aerial roots, which become embedded in gelatinous matter during the monsoon rains.

Melinis minutiflora. Efwatakala-, Molasses- or Stink-Grass. A hairy, viscid, semi-creeping perennial, 3–4 ft. high, resembling Mauritius Grass, native of Brazil. It forms a dense mass and is well spoken of in Rhodesia for fodder or hay purposes, "yielding about 5 tons of dried hay per acre." Introduced, with promise of success, at the Peradeniya Experiment Station, Ceylon, in 1923, but is no better than the well-known "Mauritius" and "Guinea" grasses. It is reputed to be repellent to the tsetse fly in Africa.

Panicum maximum. Guinea Grass; Rata-tana, *S.* This well-known grass, a native of Trop. Africa, cultivated in all tropical countries and is probably the best fodder-grass of the tropics. In Ceylon it holds first place at low and medium elevations, being fed to dairy and draught cattle as well as to horses. With liberal cultivation and manuring, it may be cut once every 3 or 4 weeks almost throughout the year. A normal yield is about 40 tons per acre, but in rich soil on flat land, with regular manuring, it may be 80–100 tons, as for example at the Hong Kong Dairy Farm, where all the manure from the cattle is applied to the fields once or twice a year. In British Guiana, it is said to have given an annual yield of 107 tons per acre "in rich though not specially prepared land." At the Experiment Station, Ceylon, the annual yield, without manure, is estimated at about 40 tons per acre (see p. 430). It thrives best on deep, alluvial, moist soil, growing to a height of 4–5 ft. or more if left uncut. It is suited to elevations up to about 4,000 ft., but growth is slower and the yield smaller up-country. It seldom produces fertile seed, but is readily propagated by root-division. Plant out in well-tilled soil, about 22 × 20 in. in average land. The first cutting may be obtained 2½–3 months after planting. Requires replanting once in 3 or 4 years, especially where cultivation and manuring are not well maintained.

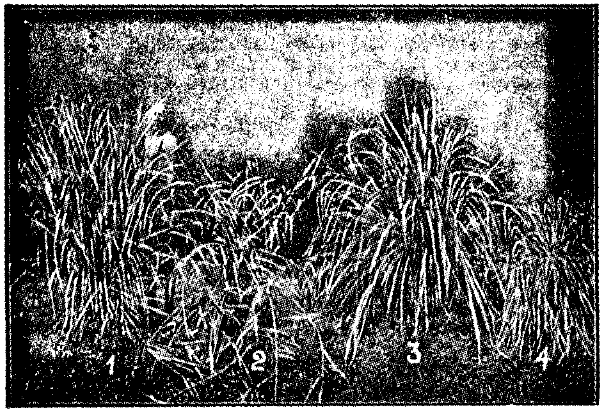
P. barbinode (= **P. muticum** or **P. molle**). Mauritius-, Para-, Water-, or Buffalo-grass; Diya-tanakola, *S.* A somewhat coarse, hairy (especially at the nodes), spreading grass with long, trailing, thick stems, thriving and spreading rapidly in moist or swampy ground. It produces soft, succulent growth, which should be cut when young, otherwise the stems become very long and coarse. It roots readily at the joints, which are said to grow after passing through cattle. In Ceylon, where it is naturalised, it thrives up to 3,000 ft. in flat, moist situations, and may be considered to rank next in importance to the Guinea-grass. It is much grown in the W. Indies, Florida, Mauritius, Bengal, etc. A native of Trop. America, it is said to have been first introduced to the Eastern tropics about 1850. Cuttings may be planted about 1½ × 1½ ft., or closer in order to cover the ground rapidly.

P. Burmanni. Pagister-, or Scotch-grass of the W. Indies. Found chiefly in wet land, very prolific and well spoken of for fodder purposes. **P. Crus-galli,** var. Cockspur Grass; Wel-marukku, *S.* An annual, 2–3 ft. high, of which there are several temperate and tropical varieties, found in the low-country of Ceylon and throughout the tropics, esteemed in India, Queensland, etc., for fodder. (See *Cereals.*) **P. repens.** Couch Grass; Etora, *S.* A widely distributed, deep-rooting, persistent grass with narrow, pointed leaves, common in Ceylon from sea-level to 6,000 ft.; thrives equally well in dry ground or marshes. Large quantities of it used to be

brought into Colombo for feeding horses and cattle, being considered to be good fodder though scanty, reaching only about 15–18 in. in height. (See *Weeds*.)

P. spectabile. African Wonder-Grass; Capim-de-Angola. Valuable for fodder, long established in Brazil and other parts of Trop. America; supposed to have been first introduced from Africa. Distinguished by long, broad leaves and bearded nodes, grows 5–6 ft. in height. Prefers moist localities and spreads rapidly when once established.

Paspalum dilatatum. Hairy- or Squat-Paspalum; Golden Crown. A low, perennial, spreading grass, indigenous to S. America, introduced to Australia, and thence to India and Ceylon about 1900. Relished by cattle and suited to medium or high elevations in the tropics, flourishing in any fairly good soil. Grown for fodder, it is estimated to yield annually from 20 to 30 tons or more per acre, according to locality. Suitable for pastures, binding railway banks, etc. Left to itself, it attains a height of from 18 to 24 in. Prop. by roots, cuttings or seed. Spacing may be 10 × 10 in. for pastures, or 15 × 10 in. for fodder. (See *Lawns*.)



PRINCIPAL FODDER GRASSES IN CEYLON.
1, Guinea-grass; 2, Water- or Mauritius-grass; 3, Paspalum virgatum; 4, Paspalum dilatatum.

P. virgatum. Upright Paspalum, as distinct from the squat Paspalum above referred to. Erect, bushy, spreading grass, 4–5 ft., with leafy stems; leaves hairy at the base. Introduced to Ceylon. An excellent fodder-grass, similar in general appearance to Guinea-grass, suited to medium and high elevations. Yields heavy crops, and cattle relish it. In S. Africa it is said to be "a great milk-producer, especially palatable to cattle." It is also well spoken of in the W. Indies. Propagated by seed (say 10 lb. to an acre), suckers, or root division. The latter may be planted about 18 × 18 in. Should be ready for cutting in 2½ months from planting, and afterwards at intervals of 3 weeks.

Pennisetum clandestinum. Kikuyu Grass. A slender, creeping, spreading perennial, 2–3 ft. high, native of E. Africa; rather resembles Doob-grass and, like the latter, is suited mainly to dry sandy soil. Not adapted to a moist climate, but is cultivated and well spoken of in S. Africa. Cuttings may be planted about 18 × 18 in., seed being seldom obtainable.

P. purpureum. Elephant Grass. A tall, coarse grass, 6–8 ft. high, with leaves 2–2½ ft. long by 2 or 2½ in. broad, native of Trop. Africa. In the young state it affords a useful green fodder and may be cut once in 6 weeks or 2 months; it tillers well and gives heavy yields, especially if irrigated. For planting, spacing should be not less than 2½ × 2½ ft. The name "Elephant Grass" is also applied to *Saccharum procerum*, a large coarse perennial, 8–10 ft. high, not suitable for fodder; also to *Typha elephantina*, a tall species of Bulrush, and others.

P. typhoideum. Napier Grass. Known to the Tamils as Kambu or Peria-manjal-cholum. A very large perennial, 8–10 ft. high, with long, rather narrow, coarse leaves, each with a white line along the centre. Stands drought well, and the leaves are liked by cattle.

Sorghum. Tall, quick-growing grasses, mostly annuals, with long, broad leaves. Different species and varieties are often grown for fodder in different countries. **S. saccharatum.** Sweet Sorghum (see *Sugar*). 8–10 ft. high, cultivated in N. India, China, Egypt, etc., for fodder, yielding a first cutting 2½ months after sowing, and 7–9 tons in the course of a season. **S. sudanense;** Sudan Grass. 6–8 ft. high, native of Sudan and Upper Egypt, similar to the latter but less robust. **S. halapense;** Johnson Grass. Perennial, with creeping stoloniferous roots, 5–10 ft. high, native of W. Trop. Asia, etc. Used as fodder, but is liable to become a weed.

Tricholaena rosea. Red-top Grass. An elegant perennial, 1½–2 ft. high, with pinkish flowering panicles, native of Natal, where it is used chiefly for hay purposes. Cultivated in Brazil (where it is naturalised), also in Australia, Florida, Rhodesia, S. Africa, etc. Thrives at medium and high elevations in Ceylon, where it was introduced in 1900. Being frequently in blossom rather detracts from its fodder value. It seeds freely.

(1) RHODES GRASS (*Chloris gayana*).
(2) RED-TOP GRASS (*Tricholaena rosea*).

Zea Mays. Maize; Indian-corn; Bada-iringu, *S.* This well-known and quick-growing crop, though usually cultivated for its grain, is sometimes grown as green fodder for dairy cattle, being cut when about two-thirds its full size. It is a most productive crop, a well-cultivated patch being known to produce about 60 tons of green fodder per acre. Suited to all warm countries, or as a summer crop in mild countries. Seeds may be sown about 12 × 12 in., in rows. (See *Food Crops*.)

OTHER FORAGE PLANTS

Many other forms of herbage and vegetable products, besides grasses, furnish useful food for stock. Concentrated food-stuffs are of course the most important, as various forms of oil-cake or poonac, brans (meal residue), crushed seeds, etc. In some countries certain fruits afford important stock-feed, as the sugary pods of the Carob Tree (*Ceratonia*) in the Levant, sweet pods of the Saman Tree (*Pithecolobium*) in S. America, and the Date fruit in Egypt, Iraq, etc. The Jak-fruit (*Artocarpus*) is relished by cattle in India and Ceylon.

Chou Moellier, Chou de Burghley or Cabbage Broccoli. Considered to be a cross between the Cabbage and Broccoli, possessing to some extent the characteristics of both and attaining a height of 4–5 ft. It may be used either as a vegetable or as food for stock, but is cultivated more specially for the latter purpose, the leaves being removed from the stems as required and fed to stock. It has become a popular vegetable in some school gardens in Ceylon.

Desmodium gyrans. Chanchala; Telegraph Plant (from the rotary motion of the two lateral leaflets, resembling semaphores). An erect leguminous perennial, 2–3 ft. high, common in the moist low-country of Ceylon up to about 3,000 ft.; relished by cattle. Other species of *Desmodium* are also valued for fodder, as *D. tortuosum*, or Beggar-weed of Florida.

Glycine hispida. Soya Bean. In subtropical countries several varieties of this annual bean attain a height of several feet and furnish valuable fodder, either in the green or dry state. (See *Trop. Vegetables*, also *Fixed Oils.*)

Hedysarum coronarium. Soola or Sulla-clover. A leguminous herb, 2–3 ft. high, valued in Australia for green fodder, said to give a yield of 40–50 tons per acre. Thrives in moist, deep, friable soil.

Pithecolobium Saman (*q.v.*). Pini-karal, *S* (Sweet Pod). The thick sugary pods of this well-known shade tree are very nutritious and much relished by cattle. They resemble the Locust-bean (*Ceratonia*), but are coarser and less sugary than the latter. In S. America they are collected and exported for cattle-food, being valued for fattening purposes.

Medicago sativa and other spp. Lucerne ; Alfalfa (of America) ; sometimes called "King of Fodders." A clover-like leguminous perennial herb, 1½–2 ft. high, native of S. Europe, Levant, N. India, etc., widely distributed and cultivated, chiefly in warm temperate or cool subtropical countries, being unsuited to tropical conditions. It is adapted to a small rainfall (20–30 in.) with irrigation, and rich, deep, calcareous soil. It may be cut from 6 to 8 times a year, giving in that period a total yield of 6–10 tons per acre. The plants continue productive for 10–15 years or more. Seed may be sown broadcast or in drills at the rate of about 15–20 lb. to the acre. Manuring is necessary, and occasional liming is beneficial, as with most clovers.

Mucuna (Stizolobium) deeringianum. Lyon Bean (*q.v.*). A quick-growing, annual, climbing bean, with stout velvety pods. This and similar free-growing beans form a valuable source of fodder, and are extensively grown for this purpose in S. United States and elsewhere. (See p. 281.)

Polygonum. An extensive genus of leafy, creeping, erect herbs or large shrubs, found throughout warm countries, usually inhabiting moist localities. Some species are used for fodder, but of the 10 indigenous to Ceylon few, if any, appear to be relished by cattle.

Trifolium alexandrinum. Berseem, or Egyptian Clover. (*Leguminosae.*) A perennial clover, similar to Lucerne, commonly cultivated in semi-desert countries, as Egypt, Syria, Mesopotamia and Persia, where it forms the principal green-food of horses, cattle, camels and donkeys. It is suited to dry, salt land, where few other plants will thrive, and requires irrigation. The crop may be cut 2 or 3 months after sowing, and several times a year afterwards, yielding about 8 tons per acre a year. It is also valued for grazing as well as for reclaiming brackish land. Berseem has been tried at different elevations in Ceylon, but without success.

PASTURE PLANTS AND GRASSES

All grasses are not equally adapted for both fodder and pasture purposes, the taller or fodder kinds being generally unsuited for close grazing or pasturing. The following include some of the usual constituents of pastures in Ceylon.

Astrelba pectinata. Mitchell Grass. A perennial, 2–3 ft., native of Queensland, where it is valued as a pasture grass, resisting drought well.

Bromus unioloides. Prairie Grass. A good pasture and hay grass in Australia. Thrives best on moist, heavy soils.

Chrysopogon (Andropogon) aciculatus. Tutteri, *S* ; Love Grass. A well-known perennial grass, common in the moist districts of Ceylon up to 4,000 ft. Forms good grazing and a close sward. (See *Lawns.*)

Cynodon Dactylon. Doob- or Doub-grass. (See *Fodder Grasses*, also *Lawns.*)

Desmodium heterophyllum. Maha-undupiyali, *S.* (*Leguminosae.*) A perennial prostrate herb, with trifoliate leaves and pale purple flowers, common in Ceylon up to 2,000 ft. An important constituent of pastures, forming a close sward.

Eleusine indica. Wal-mal-kurakkan, *S.* An annual grass, forming good pasture, common at low and medium elevations.

Eragrostis tenella. A slender annual, spreading grass, of which there are several forms. Found all over the low-country of Ceylon.

Justicia procumbens. Mayani, *S.* (*Acanthaceae.*) A prostrate spreading herb, commonly found among grass in the moist region, at all elevations.

Oplismenus (Panicum) compositus. A slender creeping grass, common in the low-country, especially in shade ; several varieties.

Panicum curvatum. An elegant slender grass, common in Ceylon, S. India, Madagascar, etc. Good for pasture or fodder. "It used to form a large proportion of the fodder collected near Colombo for horses" (Ferguson).

P. prostratum. Samay-pillu, *T.* A slender creeping grass, common in the drier parts, much relished by cattle.

Paspalum scrobiculatum. Amu, *S* ; Waragu, *T.* A variable grass, 2–6 ft. high. Several varieties known by different local names. Common from sea-level to 6,000 ft. ; resists drought well, and cattle are fond of it. (See *Cereals.*)

P. conjugatum. A slender, leafy grass, especially suited to moist shady places, 10–12 in. high, native of W. Indies, naturalised in Ceylon, etc., common under trees and along roadsides. Known in Philippines as Bitter-grass and in W. Indies as Sour-grass. (See *Andropogon pertusus.*) This grass appears of late to be superseded in Ceylon by *Paspalum obtusifolium*, see below.

P. dilatatum. (See *Fodder Grasses.*)

P. (Digitaria) longiflorum (= **P. filiculme**). A slender, perennial, creeping grass, common in Ceylon from sea-shore up to 3,000 ft. or higher. Resists drought well, and is often the first grass to become established on new clearings in the low-country. A good pasture or lawn grass for low elevations.

P. sanguinale. Guruwal, *S.* A common grass of India, Ceylon, etc. ; sometimes a troublesome weed. Forms good pasture, and cattle relish it.

P. obtusifolium. A perennial, shade-loving grass, introduced from Mexico, naturalised in Ceylon and common in moist shade, as under trees and along roadsides, often to the exclusion of all other grasses, at medium and high elevations ; distinct by its broad, sinuate leaves ; forms good grazing.

Pennisetum cenchroides. Congayam Grass. A perennial, 10–12 in. high, specially suited to dry districts. A good pasture grass in S. India.

Ruellia ringens. Nil-puruk, *S.* (*Acanthaceae.*) A perennial straggling herb, commonly found among grass in the low-country.

Sporobolus diander. A moderate-sized grass, common throughout Ceylon and the Eastern tropics generally.

Stenotaphrum complanatum. A creeping leafy grass, 1–1½ ft. high, with glabrous leaves. Thrives in partial shade. Grows under Casuarina trees in Mauritius and forms good grazing. **S. americana ;** Pimento Grass. Similar to the above. Flourishes under Pimento trees (Allspice) in the W. Indies.

BROWSE- OR FAMINE-FODDER PLANTS

In times of scarcity of cattle food, as during a prolonged and severe drought, cattle or stock will eat almost anything that is green or juicy ; thus, even gorse, rubber trees, tea bushes, palm leaves, etc., may be consumed with relish. The following may be mentioned as well-known browse plants, which resist drought well and are sometimes valued as feed for stock.

Atriplex nummularia. Salt-bush. (*Chenopodiaceae.*) This and other species, which are perennial bushy plants and thrive in arid districts or on dry sandy soil near the sea-coast, form an important food for stock in Australia and elsewhere during periods of drought.

A. repens. Elechivi, *T.* A small, prostrate, succulent shrub, common on the sandy shores in the drier parts of Ceylon, S. India, etc. The Tamils of Jaffna eat the leaves as a vegetable.

Cytisus proliferus. Tree Lucerne ; Tagasaste. A small leguminous tree, indigenous to the mountains of the Canary Islands, where the leafy branches are commonly used as food for cattle, being cut twice a year. Thrives at Nuwara Eliya in light, friable soil. **C. stenopetalum** ("Garcia" of the Canary Islands) and **C. pallida** ("Garcia Blanca") are similar species with yellow and white flowers respectively, also much used for fodder purposes.

Mikania scandens. Lo-ka-palu, *S* ; Mikania Weed ; Mile-a-minute (referring to the rapid rate of growth). This annual herbaceous creeper, considered to have been introduced from S. America, is now a common weed in waste ground throughout the moist low-country of Ceylon, S. India, Malaya and Pacific Islands, from sea-level to about 4,000 ft. Yields a quantity of soft, succulent stems and foliage,

which are relished by cattle, especially in the dry season when food is scarce. (See *Weeds.*)

Opuntia Dillenii. Prickly Pear. This and other species of Opuntia have become a serious pest in some warm countries, notably Queensland. In periods of drought, however, they serve a useful purpose as stock feed, the succulent spiny growths being boiled or crushed and flavoured with salt, or mixed with ensilage or other fodder, and in this way are said to have a fattening effect. A spineless form, said to have been raised by the late Mr. Burbank in California, is preferred for stock feed. (See *Edible Fruits,* also *Weeds.*)

Prosopis juliflora. Mesquit-, Cashaw-, or Algaroba-bean. A small leguminous tree of Trop. America and W. Indies, the leaves, shoots, and pods of which are used as food for stock, the pods being said to be "as nutritious as corn." Introduced and acclimatised in Hawaii and other countries with a rather dry climate, thriving up to 2,500 ft. The seeds are said to pass through cattle and horses uninjured. (See p. 263.)

GRASSES AT THE EXPERIMENT STATION, PERADENIYA, CEYLON

Showing yields for 2 years and Food units per acre.

	1921–1922. (12 months.)		1922–1923. (12 months.)		Average per year.	
	Yield per acre.	Food units per acre.	Yield per acre.	Food units per acre.	Yield per acre.	Food units per acre.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
Guinea-grass, var. A. (*Panicum maximum*)	40·8	5·80	34·8	4·94	37·8	5·37
Guinea-grass, var. B. (*P. maximum*)	39·4	7·52	26·5	5·05	32·9	6·27
Mauritius-grass (*Panicum muticum*)	33·2	5·41	—	—	—	—
Golden Crown Grass (*Paspalum dilatatum*)	22·7	6·47	34·1	9·58	28·4	8·09
Upright Paspalum (*P. virgatum*)	27·8	4·70	21·5	3·65	24·6	4·16
Rhodes-grass (*Chloris Gayana*)	29·2	4·15	15·9	2·26	19·4	2·76

SECTION V

CHAPTER XXXII

(1) *PERFUME-YIELDING PLANTS.*
(2) *SELECTED BEE PLANTS.*
(3) *REMARKABLE FRUITS, TREES, SEEDS, ETC.*
(4) *INSECTIVOROUS AND FLY-CATCHING PLANTS.*
(5) *MYRMECOPHILOUS PLANTS.*
(6) *SACRED TREES.*

Scents in plants.—These are usually in the form of volatile or essential oils (*q.v.*) and contained in minute sacs, as often found in flowers. They serve to attract insects, on which many plants depend for their pollination. Many flowers, especially in the tropics, attract insects by their size and brilliance, and therefore possess little or no fragrance. Scents are not confined to flowers alone, but may be found in various parts of plants, as in leaves (*e.g.* citronella, geranium, etc.), bark (as in cinnamon), fruit (nutmeg, ajowan, vanilla), seed (tonka bean), roots (vetiver grass), or wood (as in sandal-wood). Scents or odours are also commonly found in resins, oleo-resins or gum-resins, which are therefore largely used in perfumery or in incense.

The cultivation of plants for their scent or aroma and the extraction of these for commercial purposes form an important industry in some countries, as in Spain, S. France, Sicily, Bulgaria, etc. Thus the cultivation of pelargoniums (for geranium oil) is carried on extensively in Réunion, Morocco, etc., as is citronella in Ceylon, lemon-grass in S. India, and cloves (for clove-oil) in Zanzibar and elsewhere.

Extraction.—Various methods are employed for the extraction of the volatile oils, as *distillation* by means of a still, used for oil-grasses, etc.; *expression* by pressure, which includes the "Sponge" process, as applied to citrus fruit and peel; the latter is pressed into an ordinary sponge, which is then squeezed by hand into a receptacle for the oil. In the *Ecuelle* method, which is another form of expression by pressure, the fruits are placed in a revolving vessel furnished with spikes, which break up the oil cells and set the oil free. *Enfleurage* is a process by which flowers are treated with purified lard, beef fat, or olive oil. A layer about ¼ in. thick of this is placed on a sheet of glass which forms the base of a wooden tray (38 × 24 × 3 in.), several of such trays being laid upon one another in tiers; over the fat is placed a layer of fresh flowers, these being replaced every second or third day until the fat becomes thoroughly charged with the perfume. It is then termed a "pomade," from which the perfume is extracted with alcohol. *Maceration,* a modification of the latter method, is adapted to flowers of a delicate nature, which are placed in a metal vessel containing hot fat or olive oil maintained at a temperature of 65–70° C. These are kept stirred mechanically, the exhausted flowers being replaced at intervals until the fat becomes fully charged with the scent, when it is called a pomade, as already stated.

ANIMAL PERFUMES

Special skill is required in the art of blending and fixing perfumes. Highly volatile scents quickly vanish unless combined with some fatty

substance to act as a base. Certain animal substances are thus employed to give superior scents a greater degree of permanence, and of these the following are of principal importance.

Ambergris, found in the intestines of the sperm-whale, sometimes floating about in the sea or on the shores of tropical countries, as in Sumatra, Madagascar, S. America, China, Arabia, etc. It is a greyish white, fatty substance, of a penetrating disagreeable odour, but when diluted in alcohol it possesses a pleasant perfume, which is of a specially permanent nature. It is insoluble in water, slightly soluble in cold alcohol, but readily soluble in hot alcohol, ether or volatile oils.

Natural musk is found in a small bag secreted in the body of the musk deer, a small animal of the Himalayas. The quantity obtained from each animal is very small, varying from 6 drams to 1½ oz., according to the size of the deer, consequently it is very expensive. It is a highly concentrated perfume, has the power of imparting permanency to very volatile perfumes, and is one of the most penetrating odours known. It is capable of being greatly diluted, and is extensively used for perfuming fine soaps and sachets.

Civet is a glandular secretion occurring in an outwardly discharging pocket underneath the tail of the civet-cat, which is sometimes bred in captivity in large numbers for the purpose of obtaining this substance, which is collected by means of a small spoon. Fresh civet is a whitish-yellow mass, of a nauseating odour; but when diluted, as in tincture, it has an agreeable scent, and is valued as a binder for other perfumes.

Castor is a secretion of the beaver, found in two pear-shaped bags on the abdomen of the animal. It is of a strong disagreeable odour, but when diluted has a pleasant smell, and is used in perfumery for fixing scents.

PERFUME-YIELDING PLANTS

The following is a selected list of sources of perfumes (see *Essential Oils*, also *Spices and Condiments*):—

Basil Oil. (*Ocimum Basilicum.*)—A herb 2–3 ft. high; volatile oil obtained by distillation of the fresh shoots and leaves, used as an addition to violet perfumes. Cultivated in Réunion, Seychelles, etc. (See *Condiments.*)

Bay Oil. (*Pimenta acris.*)—See *Spices.* Oil distilled from the leaves used as a perfume for shaving soaps and in the hair-wash known as "Bay rum."

Bergamot. (*Citrus Bergamia.*)—Bitter Orange. The peel yields a valuable perfume-oil known as "bergamot." About 1,000 peels are required to produce 30 oz. of the oil, which is usually valued at 35*s.*–50*s.* per lb., according to purity. The tree requires much the same treatment as the Sweet-orange, and in plantations is generally planted about 12 ft. apart each way. A variety of Bitter-orange, called the "Bigardier," is valued for its flowers, a kilogramme of which yields on an average 2 grammes of essence, which is usually worth from £12 to £18 per lb. according to quality and demand.

Carnations. (*Dianthus.*)—The flowers of scented varieties are used extensively in perfumery.

Cassia Oil. (*Cinnamomum Cassia.*)—See *Spices.* Used in scenting soaps, etc.

Cassie-flowers. (*Acacia farnesiana.*)—A small thorny tree or shrub, common in the tropics and subtropics, largely grown in S. France for the flowers, which yield by enfleurage a choice perfume.

Cedrat or **Citron.** (*Citrus medica.*)—A highly scented oil obtained from the rind is worth about 15*s.* or more per lb. Used largely in handkerchief perfumes.

Citronella Oil (*q.v.*). Used mainly for scenting toilet soaps, etc.

Clove Oil. See *Spices.* Used for perfumery, scenting fine soaps, etc.

Eucalyptus Oil. Obtained from several species of Eucalyptus; that from *E. citriodora*, the Lemon-scented Gum, is of special value in the perfumery trade.

Frangipani. The odour of the white, cream or crimson, fleshy flowers of the Temple Tree (*Plumeria spp.*) closely resembles the perfume "frangipani," and it is considered that it would pay to extract the scent by enfleurage. (See *Flowering Trees.*)

Geranium Oil. (*Pelargonium capitatum, P. odoratissima,* and *P. roseum.* Geraniaceae.)—Shrubby, fragrant plants, suited to a rather dry warm climate, cultivated extensively in Réunion, N. Africa and S. Europe. A delightful rose-scented oil, obtained by distillation from the strongly scented leaves and shoots, is usually worth about 3*s.*–5*s.* per oz. In plantations 5,500–6,000 plants are allowed to the acre, spacing being about 3 × 2 ft.; 3 clippings are obtained in one season, and replanting is done once in 4 years. Considerable quantities of the leaves are exported annually from Réunion for the extraction of the oil.

Jasmine. (*Jasminum spp.*)—The perfume or otto obtained from Jasmine flowers is one of the most prized by perfumers on account of its delicate odour, which it is said to be impossible to imitate, being usually worth about £9 per fluid ounce. In S. France about 5,000 Jasmine plants go to the acre, yielding about 5 cwt. of blossoms, sufficient to perfume 1½ cwt. of fat or pomade, valued at about 12*s.* per lb. *J. Sambac* is especially noted for its strongly scented flowers (see fig. on p. 107).

Lavender Oil. (*Lavendula vera.*)—Cultivated commercially in Europe both for its dried blossom, used for scenting wardrobes, and for the essential oil distilled from the fresh flowers. 3,720 lb. of flowers yield about 14 lb. of oil. English Lavender is considered the best in the market.

Lemon-grass or **Verbena Oil.** See *Essential Oils.* Commonly used for scenting soaps, being more valuable than Citronella oil.

Musk Mallow; "Ambrette" of the French. (*Hibiscus Abelmoschus.*)—An annual shrub with large, mallow-like flowers. Seeds yield an oil of a musk-like odour, used in inferior perfumes and worth about 1*s.* 6*d.* per lb.

Musk Plant. (*Mimulus moschatus.* Scrophulariaceae.)—A small creeping, herbaceous, viscid plant with yellow flowers. Until a few years ago this was a very popular garden plant in cool countries on account of its pleasant fragrance. It has now become entirely void of scent in every country, even in its native home of N. America,—a puzzle to botanists and horticulturists.

Orris-root. The rhizomes of *Iris florentina*, cultivated commercially in S. Europe. Dried and powdered, they are used in perfumes, cosmetics, etc.

Otto, or Attar, of Roses, obtained from rose petals (chiefly *Rosa damascena* or varieties), is perhaps the most valuable of all scents, and forms the basis of most superior perfumes. Cultivated extensively in Bulgaria in the form of hedges about 3 × 2 ft., say about 6,000 plants per acre. After the second year an acre is estimated to produce about 600 lb. of rose petals a year, and when 5 years old about 3,500 lb. 200 lb. of petals yield about 3 oz. of the otto, which is usually valued at £12 to £15 or more per oz. Some 500 lb. of otto are imported into England annually from Bulgaria. *Rosa centifolia* is cultivated in S. France for the production of "Oil of Rose" or "Rose essence."

Patchouly or **Patchouli.** See *Essential Oils.* The dried leaves and young tops yield by distillation a volatile oil from which is prepared an essence popular in India as well as in parts of Europe as a scent and used in the blending of perfumes.

Priprioca. (*Ocotea* (*Mespilodaphne*) *pretiosa.* Lauraceae.)—A Brazilian tree, found in the forests of Amazonia. The leaves when bruised give off an agreeable odour, "recalling clove, cinnamon and bergamot; yield an oil known as "wood-oil" and recommended for use in perfumery, also as a spice.

Rosemary Oil, obtained by distillation from the herb *Rosmarinus officinalis*; manufactured extensively in S. France, Spain, etc., for use in perfumery.

Tonka- or **Tonquin-bean.** Serappia (Venezuela). (*Dipteryx odorata.* Leguminosae.)—A large tree with pinnate leaves, native of Brazil, Venezuela, British Guiana, etc., introduced to Ceylon in 1881. The fruit is a small, oblong, fibrous pod, containing one almond-shaped black or brownish and strongly fragrant seed. The latter is the Tonka-bean of commerce which, on account of its odour of new-mown hay, due to the presence of *coumarin*, is especially valued in perfumery and used in the preparation of sachet powders, scenting soaps, tobacco, snuff, etc. "Tincture of tonka" is used by pastry-cooks and confectioners as a substitute for vanilla for flavouring. The seeds are subjected to a crystallisation process, being soaked in rum for 24 hours and then slowly dried, when they become covered with a white crystalline substance (coumarin). Tonka-beans fluctuate greatly in price, according to supply and demand, from about 4*s.* to 8*s.* per lb. *D. oppositifolia* also furnishes the commercial article to some extent.

Tuberose. (*Polianthes tuberosa.* Liliaceae.)—A tuberous herbaceous plant, much cultivated in S. Europe for the perfume obtained by enfleurage from the strongly scented flowers. The plant thrives in up-country gardens.

Verbena Oil. Lemon-scented Verbena. (*Lippia citriodora.*) A small slender shrub with strongly fragrant leaves, from which is obtained an essential oil valued in perfumery; cultivated in Morocco, etc., for the leaves.

Vetiver or **Vetivert Oil** (*q.v.*), distilled from the roots of Khas-khas or Khus-khus grass, much valued for use in perfumery, chiefly for fixing volatile odours and scenting high-class soaps. The powdered roots are used in Indian scents.

Wattle-blossom ; "Mimosa" of florists. *Acacia dealbata*, *A. pycnantha* and other species are richly scented and recommended for use in perfumery.

Wintergreen Oil, or Oil of Gaultheria, obtained from species of *Gaultheria* (*Ericaceae*), chiefly *G. procumbens* of N. America. *G. fragrantissima* or "Wal-kapuru" is a small up-country shrub of Ceylon, India, etc. It is the heaviest of all essential oils, and is obtained from the leaves by distillation. Commercial Wintergreen oil is also obtained by distilling the bark of *Betula lenta*, a species of Birch (Betulaceae).

Ylang-ylang, or **Ilang-ilang ;** Wana-Sapu, *S.* (*Cananga odorata.* Anonaceae.) —A large, quick-growing, soft-wooded tree, 60–80 ft. high, native of the Philippines, Java, etc., sometimes cultivated for the large, greenish-yellow flowers, which are strongly scented and yield by distillation the popular scent known in the Philippines as "ylang-ylang" or "ilang-ilang," and in Java as "Cananga." A full-grown tree is considered to yield about 20 lb. of fresh flowers during a season. About 200 lb. of flowers produce 1 lb. of the essence. It is estimated that an acre planted with 150 trees (*i.e.* 17 × 17 ft. apart) produces some 3,000 lb. of flowers. The main supply, however, is from uncultivated trees from which the peasants collect the flowers, and sell them for about 2*d.* per lb. The annual export of ylang-ylang oil from the Philippines is valued at about £20,000. The oil is also produced in Madagascar and Java, where the tree is partly cultivated. The tree is naturalised in Ceylon, where, however, the flowers are not utilised. The oil is used for high-grade perfumes and usually commands from 10*s.* to 15*s.* per lb., Java oil generally fetching the highest price.

Among other species which furnish scented flowers the following may be mentioned :—

TREES :

Caesalpinia coriaria. Divi-divi.
Cassia nodosa. Pink Cassia.
Citrus decumana. Pomelo.
Fagraea fragrans. Tembusu (Malaya).
Mesua ferrea. Ceylon Iron-wood.
Michelia Champaca. Champac; Sapu.
Murraya exotica. Etteriya, *S.*
Myristica Horsfieldii.
Nyctanthes Arbor-tristis. Sepalika, *S.*, or Night-flowering Jasmine.
Haematoxylon campechianum. Logwood.
Tabernaemontana coronaria. Wax-flower.

SHRUBS :

Brunfelsia hopeana (B. uniflora.)
Cestrum nocturnum. Queen-of-the-Night.
Gardenia florida. Gardenia.
Heliotropium vars. Heliotrope.
Lawsonia alba. Mignonette Tree.
Magnolia fuscata. Mathanakama, *T.*
Ocimum basilicum. Basil. **O. sanctum.** Madura-tala, *S.*
Stemmadenia bella.
Talauma mutabilis.

CLIMBERS :

Artabotrys zeylanicus. Petika-wel, *S.*
Asparagus falcatus. Hathawariya, *S.*
Camoensia maxima.
Jasminum, several spp.
Lonicera Hilderbrandtii. Giant Honey-suckle.
Odontadenia speciosa.
Pergularia odoratissima. Tonkin Creeper.
Stephanotis floribunda. "Stephanotis."

SELECTED BEE-PLANTS

Bees have their likes and dislikes in regard to the flowers they visit for extracting honey, and the quality of the honey produced depends largely on the flowers they frequent. Persons who have taken up bee-

keeping in tropical countries must have sometimes experienced a difficulty in providing a sufficient supply of suitable flowering plants or trees for their bees; to these the following list may be a guidance. DRIEBERG, who has given the subject much attention, states that Ceylon bees seem to travel great distances in search of honey-flowers, often preferring trees or shrubs to smaller plants. In the W. Indies, "Logwood" honey is considered to be of superior quality, while the Pigeon-pea (*Cajanus indicus*) and other leguminous flowers, the Orange, Lime and other Citrus trees are also considered to yield excellent honey. The following are some well-known bee-visiting species.

(T.) = Tree; (Cl.) = Climber; (S.) = Shrub;
(H.P.) = Herbaceous Perennial; (A.) = Annual.
See also *Perfume-yielding Plants.*

Acacia dealbata. Silver-wattle. (T.)
Angelonia salicariaefolia. Purple and white vars. (H.P.)
Antigonon Leptopus, and other spp. (Cl.)
Azalea indica, vars. (S.)
Bassia longifolia. "Mi," or "Illuppai." (T.)
Caesalpinia coriari. Divi-divi. (T.)
Cajanus indicus. Pigeon Pea.
Canarium commune. Java-almond. (T.)
Caryota urens. Kitul; Toddy Palm.
Cassia grandis. Horse Cassia. (T.)
C. nodosa. Pink Cassia. (T.)
Choisya ternatea. (S.)
Citrus, including Lime, Orange, etc. (S. or T.)
Cocos nucifera. Coconut Palm. (T.)
Cytisus proliferus. Tree Lucerne. (T.)
Elaeocarpus serratus. Wild Olive. (T.)
Euphorbia heterophylla. (H.P.)
Glycosmis pentaphylla. (S.)
Grevillea robusta. Silky Oak. (T.)
Guizotia olifera. (A.)
Heliotrope (*Heliotropium*). (P.)
Humboldtia laurifolia. (S. or T.)
Ipomoea carnea and other spp. (Cl.)
Kleinhovia hospita. (T.)
Latania, several spp. and vars. (S.)
Logwood (Haematoxylon). (T.)
Lupinus, different vars. Lupins. (A.)
Mangifera indica. Mango. (T.)
Michelia Champaca. Sapu. (T.)
Mignonette. (Reseda odorata.) (A.)
Murraya exotica. (S. or T.)
Nasturtium (Tropaeolum). (A. Cl.)
Phlox Drummondi. (A.)
Pometia eximia. (T.)
Porana volubilis. (Cl.)
Portulaca vars. Purslane; Genda-kola.
Pterocarpus indicus. (T.)
Rhus glabra. (T.)
Sarcocephalus esculentus. (Cl. S.)
Schleichera trijuga. (T.)
Strobilanthes, various spp. (S.)
Terminalia belerica. Bulu, *S.* (T.)
Turnera elegans. (H.P.)
Zinnia linearis. (H.P.)

FAMOUS TREES

Oldest Trees.—The claim of being the oldest trees in the world is shared by various species in different parts of the tropics or subtropics. The age of some of the Giant Redwood trees of California [*Sequoia* (*Wellingtonia*) *gigantea*; Coniferae], as shown by the rings of growth in the trunk of felled specimens, has been estimated at some 4,000 years; while a measured living specimen has been found to be 325 ft. in height, with a diameter of 30 ft. at 4 ft. from the ground.

A Cypress tree (*Cupressus*) at Chapultepec in Mexico is believed to be 6,000 years old, and a large tree of *Dracaena Draco*, or Dragon Tree (Liliaceae) at Orotava, Teneriffe, is thought by some to be the oldest vegetable inhabitant of the earth. A Bo- or Peepul-Tree, *Ficus religiosa* (see "Sacred Trees"), at Anuradhapura, Ceylon, is supposed to be the oldest historical tree known. It was brought as a young plant from India in 288 B.C. and is still flourishing, or at least a portion of it is. Certain Olive trees near Jerusalem are stated to have been planted 800

years ago. The Baobab Tree (*Adansonia*) lives to a great age and attains a diameter of some 30 ft. in thickness of trunk. (See p. 195.)

Tallest Trees.—The foregoing records of the Californian Redwood appear to be challenged for some of the Eucalypti in Australia, notably *E. amygdalina* or Peppermint Gum, specimens of which have been described with heights varying from 350 to over 400 ft. A measured specimen on being felled is said to have measured 303 ft. The " Douglas Fir " (*Pseudotsuga Douglasii*) of N. America, grows to a height of 230 ft. A single spar flagstaff in the Royal Botanic Gardens, Kew, brought from British Columbia in 1914 is 215 ft. high.

REMARKABLE TREES, PLANTS, FLOWERS, ETC.

The **largest flower** in the world is *Rafflesia Arnoldii* (Rafflesiaceae), named after Sir Stamford Raffles, a former British Governor of Malaya. It is found in Malaya, attains a size of about 2 ft. across, weighs about 15 lb., smells like putrid meat and attracts flies, on which its fertilisation depends. It is pinkish-yellow and mottled, with 5 regular petals or perianth lobes, which are $\frac{1}{4}$–$\frac{3}{4}$ in. thick, with a round cup-shaped corona in the centre. The plant consists of the flower alone, which arises from a fungus-like growth, being parasitic on trailing stems or roots of a *Vitis*.

Giant Fly-catcher. (*Aristolochia gigas.*)—Considered a native of S. America and W. Indies. Flower (perianth) 7–8 in. broad with a sinuate, tapering tail 20–24 in. long. (See p. 118.)

Giant Water-lily. (*Victoria regia.*)—This is one of the most remarkable of plants. Discovered in Brazil in 1801, it was brought to Europe in 1837 and named in honour of the late Queen Victoria. The immense, circular, floating tray-like leaves measure up to 5 to 7 ft. across, with an upturned margin of about 3 in. (See p. 168.)

Giant Orchid. (*Grammatophyllum speciosum.*)—(See p. 139.)

Gunnera manicata. " Ape-ape." (*Haloragaceae.*)—A stemless herb with coarse, rhubarb-like enormous leaves, 5–7 ft. across

Giant Aroid. (*Amorphophallus Titanum.*)—A native of Sumatra, it sends up once a year an erect solitary leaf, with a stout stalk 10 ft. high and a blade 4–5 ft. across, pedately compound. The spadix (flower) is 5 ft. high, with a spathe 3 ft. across. Somewhat similar is *Godwinia gigas* of the same family. (See p. 131.)

Giant Palm, or **Talipot.** (*Corypha umbraculifera.*)—Native of Ceylon and largest of the palm tribe. Takes 25–40 years or more to attain maturity and flowering stage, and about 2 years more to produce and ripen fruits, after which it dies. (See pp. 160, 501.)

Fan Palm. (*Wallichia disticha.*)—(See p. 158.)

Fan Tree, or Traveller's. (*Ravenala madagascariensis.*)—(See p. 100.)

Rambong or India-rubber Tree. (*Ficus elastica.*)—A spreading soft-wooded tree, remarkable for its saurian-like semi-aerial roots. (See p. 95.)

Giant Bamboo (*Dendrocalamus giganteus*) of Burma. The largest of the bamboo family, attaining a height of 100–120 ft., forming enormous closely grown clusters. (See p. 165.)

Resurrection Plant, or **Rose of Jericho ;** Kaf Maryan. (*Anastatica hierochuntina.* Cruciferae.)—A dwarf desert plant, found in Arabia, Palestine, Syria, etc. When the seeds have ripened, the leaves drop and the small branches fold inwards, forming a grey ball-like wickerwork, which is blown about by the wind. It quickly opens out and revives on being placed in water or moist soil.

REMARKABLE FRUITS, ETC.

Barringtonia speciosa. Mudilla, *S.* A large, curious, 4-angled, cone-like fruit. See *Ornamental Fol. Trees.*

Cassia Fistula. Pudding-pipe ; Eh-ela, *S.* Long cylindrical brown pods, up to 3 ft. in length. See *Flowering Trees*, etc.

Couroupita guianensis. Cannon-ball. Large, round, brown fruits, each the size of a man's head or larger. See p. 84.

Crescentia Cujete. Tree Calabash. (*Bignoniaceae.*) Large ovoid or round fruit. The hard, smooth shell takes a fine polish. It is carved and made into ornaments, also commonly used in Trop. America and W. Indies for cups, basins and other articles of domestic use. The larger fruits are 8–10 in. or more in diameter. A small tree, native of Cuba, where it is commonly planted around dwellings. **C. plectrantha.** Fruit similar to above, but usually round-shaped.

TREE CALABASH (*Crescentia Cujete*). Showing large, smooth, hard-shelled fruit, whole and in section.

Curcurbita maxima. Pumpkin ; Wattakka, *S.* The shell of the immense, round, smooth fruits, emptied of the pulp and seeds, becomes hard, light and durable ; commonly used in the tropics for carrying purposes, etc.

Entada scandens. Elephant Climber. An immense jungle climber or liane ; the flat pods are 3–5 ft. long by about 4 in. broad, and contain large, brown, flat seeds. Forests of moist low-country of Ceylon. See *Lianes*, also *Ornamental Seeds.*

Hura crepitans. Sandbox Tree (see *Poisonous Plants*). The circular, hard fruit, flattened at both ends, is divided into several rounded sections, each containing one seed. The sections dehisce explosively with a loud report. By dropping melted lead into the hollow centre the sections may be held together and the fruits used as paper-weights.

Hydnocarpus octandra. (*Bixaceae.*) Round, jet-black, velvety, pendulous fruits, of the size of oranges.

" Jumping Beans." The maggot of a moth (*Carpocapsa saltitans*) is hatched inside the small, half-round capsule of certain Euphorbiaceous trees in Mexico, whence the " beans " are exported as a curiosity. Warmth renders the maggot active, making the " beans " (or rather the maggot inside them) roll or jump about.

Kigelia pinnata. Sausage Fruit. See p. 96.

Lagenaria vulgaris. Bottle Gourd. Variously shaped, large gourds, often bottle- or club-shaped. See *Gourds.*

Lecythis Ollaria and **L. Zabucajo.** Monkey Pot. A large, hard, woody, brown fruit, furnished with a close-fitting woody lid at the top, resembling a pot. The genus is remarkable for its curious fruits. See p. 238.

Lodoicea sechellarum. Double Coconut ; Coco-de-mer. A remarkable palm with immense fruits. See fig. on p. 160.

Martynia diandra. Snake's Head ; Tiger's-claw ; Naga-darana, *S* ; Naka-tali, *T.* (*Pedaliaceae.*) Hard, woody, oblong fruit, $1\frac{1}{2}$–2 in. long, ends in 2 strong, curved spines. Shrubby annual native of Mexico, naturalised in Ceylon.

Ochroma Lagopus. Down Tree. Curious, brown fruits, borne erect on the branches; when the fruit dehisces it resembles a brush of soft, brownish down. See p. 213.

Ochrosia acuminata. (*Apocynaceae.*) Bright red, ovoid, fleshy fruits, 1½–2 in. long; ornamental but poisonous. Produced by a small tree of Java.

Oroxylum indicum. Totila, *S. Bignoniaceae.* Deciduous small tree, producing large, curved pods, almost the size of cricket bats. Seed with flat, circular, white membranous wing.

Pandanus Leram. Nicobar Bread-fruit. See p. 98.

Parmentiera cerifera (*q.v.*). Remarkable, candle-like, pale-yellow fruits, borne in great profusion on stem and branches. See p. 97.

Sarcocephalus esculentus. Globular receptacle studded with small white fls., resembling a pin-cushion. See p. 264.

Sterculia Balanghas. Nawa, *S.* Large, bright orange-yellow or scarlet, shell-like fruit; when dehisced it exposes shiny, jet-black seeds, suspended from the margins of the carpels. See below.

Tabernaemontana dichotoma. Forbidden Fruit; Eve's Apple; " Divi-kaduru," *S.* (*Apocyanceae.*) A small tree of Ceylon, S. India, etc., with pale-grey bark and white, scented fls., common at low elevations. The curious pendulous fruit, orange-yellow when ripe, is half-round, with a clean-cut depression along one side, which has suggested the popular names, being supposed to resemble a partly eaten fruit. Some even imagine they see in it the marks of Eve's teeth.

PIN-CUSHION FRUIT
(*Sarcocephalus esculentus*).

NAWA (*Sterculia Balanghas*).
(A) Red fruit unopened; (B) Fruit open, showing scarlet inside with glossy black seeds adhering to margins of carpels.

ORNAMENTAL SEEDS

In the tropics are found many curious or ornamental seeds, suitable for making articles of ornament or utility, as beads, necklaces, rosaries, screens, buttons, etc. It is noteworthy that the majority of such seeds are furnished by the families of Leguminosae and Palms, although some are also produced by the orders Euphorbiaceae, Apocynaceae, Scitamineae, etc. Boring the seeds for necklaces, etc., may be effected by holding each

seed firmly in one hand and passing a red-hot wire through it with the other. No attempt should be made to soften the seed by soaking in water, which will result in loss of brilliancy and colour, and possibly in the swelling and splitting of the seed. The following are some of the more striking of such seeds:

Abrus precatorius. Crabs'-eyes; Olinda-vel, *S*; Kuntumani, *T*. Small, scarlet shiny seeds with a black spot; used for rosaries, necklaces, goldsmiths' weights, etc. See *Poisons.*

Adenanthera pavonina. Bead Tree; Barricari-seeds; Madatiya or Mad-eta, *S*; Anai-kuntumanai, *T*. Seeds bright scarlet, used for necklaces, etc., also for jewellers' and apothecaries' weights, each seed weighing nearly 4 grains; produced by a tall, erect tree with fine, feathery foliage. **A. bicolor.** Mas-mora, *S.* Seeds smaller than the latter, half-black and half-red, very ornamental; produced by a moderate-sized tree with small pinnate leaves and spreading top, native of Ceylon, Malacca, etc.

Caesalpinia Bonduc. Nicker-seeds; Kumburu-wel, *S*; Punaikkalaichi, *T*. Large, ash-grey, polished, very hard seeds, which are globular or ovoid, about the size of marbles, produced by a large woody climber.

Canna indica. Indian-shot; Butsarana, *S* (= " Help from Buddha "). Seeds black, round or ovoid, of the size of small peas, very hard; used in rosaries by Buddhist worshippers.

Coix Lachryma-Jobi. Job's Tears, Keekirindee, *S.* Very hard, grey, brown or mottled, polished seeds (fruits); used for rosaries, bead-work, etc. Sometimes made into effective " bead " curtains. See *Cereals.*

Corypha umbraculifera. Talipot Palm. Seeds round, of the size of marbles, hard and creamy-white, used for buttons and ornaments. See *Glossary, etc.*

Elaeocarpus Ganitrus. The round, warty, brown fruits, bright blue when fresh, may be used when dry as heads for hat pins, etc.

Entada scandens. Elephant Creeper. Very large, flat, brown, polished seeds, made into snuff-boxes, charms, etc. See *Remarkable Fruits.*

Erythrina corallodendron. Coral-bean Tree. Seeds scarlet, with a black spot; sometimes strung as beads in chaplets, but are too fleshy to be durable.

Hevea brasiliensis. Para-rubber Tree. The large, roundish, mottled or blotched seeds may be made into heads for hat-pins and ornaments.

Manihot Glaziovii. Ceara-rubber Tree. Oblong, flattened, hard seeds, mottled grey and brown.

Metroxylon Sagu. Sago Palm. Round or cone-shaped reddish-brown fruits, with a rind formed of hard, polished, brown persistent scales.

Mucuna pruriens. Horse-eye Bean; Cowage or Cowitch; Achariya-pala, *S.* The large ovoid mottled seed considered to resemble the eye of a horse. Pods covered with brown irritant hairs, formerly used as a vermifuge.

Ormosia coccinea. Necklace Tree; Gunda- or Kunda-mani, *S* and *T*. Seeds large, roundish, hard, bright scarlet, blotched with black and brown. Very popular for buttons, necklaces and ornaments. Produced by a moderate-sized tree of Trop. America, introduced to Ceylon in 1886. Principal season, Dec.–Feb. **O. dasycarpa.** Seeds similar to the above, but smaller.

Phyllanthus cyanospermus. Sudu-liyan, *S.* Medium-sized tree of Ceylon. Seeds rather small, triangular, bright, shiny, metallic-blue.

Phytelephas macrocarpa. Ivory-nut Palm. The large, hard, white, ivory-like seeds are used for vegetable-ivory, being employed in the manufacture of buttons, etc. Exported from S. America. See *Palms.*

Raphia Ruffia and other species. Raffia Palm. Round or conical, large, brown, polished, scaly fruits, suitable for ornaments.

Sapindus saponaria. Soap Berry or Soap-berry Tree. The round, black seeds are often strung as beads or rosaries; sometimes used as buttons.

Thevetia neriifolia. Lucky-beans or Lucky-seeds. The hard, oblong seeds sometimes used as pendants or charms. See p. 205, etc.

INSECTIVOROUS AND FLY-CATCHING PLANTS

Aldrovanda vesiculosa. Water Fly-trap. (*Droseraceae.*) A rootless, floating water-plant, remarkable for the inflated extremities of the sensitive leaves, which act as floats and capture minute water animals, which the plant digests. Tropics.

Aristolochia, many species. Fly-catching Plants. A remarkable family of plants, mostly climbers, with variously shaped fls., which in some are very large (see p. 118); most have an offensive odour, which attracts carrion flies. The fls. are adapted to entrap the latter, which are unable to escape owing chiefly to the numerous hairs in the tube which point inward. The flies are essential to the pollination of the fls., and when this is effected the hairs collapse, enabling the flies to escape. See *Flowering Climbers.*

Cephalotus follicularis. Pitcher Plant of Australia. (*Cephalotaceae.*) A remarkable marsh plant of W. Australia, bearing two kinds of lvs., one form being transformed into pitchers which capture insects much in the same way as Nepenthes.

Darlingtonia, several spp. Californian Pitcher Plant. (*Sarraceniaceae.*) A remarkable genus of perennial herbs, found in marshy ground in California. The leaf-petioles, as in Sarracenia, are formed into long pitchers, with the divided lamina or blade at the top.

Dionaea muscipula. Venus's Fly-trap. (*Droseraceae.*) A small, remarkable marsh plant of S. United States. The spathulate lvs. are furnished along the margins with peculiar bristles or teeth, which are extremely sensitive and when touched by an insect close immediately and entrap the intruder; the latter being imprisoned until dead, the plant absorbs the product of its decay, and the lvs. open again. The leaves, however, will close if touched by any solid substance, as a pencil-point.

Dischidia rafflesiana. Leaf Pitcher Plant. (*Asclepideae.*) A climbing plant with two forms of lvs., indigenous to Malaya and Trop. Australia. The tubular leaf is formed into a pocket 3–5 in. long, with a small aperture at the top, serving as a receptacle for water and insects, and an adventitious root from the stem develops into it.

Drosera, many spp. Sundew. (*Droseraceae.*) A genus of small plants, found in wet regions. Three species are indigenous to the montane zone of Ceylon. Lvs. thickly set with glandular sensitive hairs, tipped with viscid fluid, by means of which insects are attracted and trapped, and their decomposition is assisted by a digestive fluid secreted by the plant.

Nepenthes, several spp. Pitcher Plant; Bandura-wel, *S.* (*Nepenthaceae.*) A genus of climbing plants, inhabiting hot and moist places in the tropics, mostly in Borneo, Malaya, etc. *N. distillatoria* is indigenous to Ceylon. A prolongation of the midrib is modified into a curious pitcher-like structure, with a lid at the top. These pitchers are in some species or varieties as much as 8–10 in. long, and generally contain a quantity of water, in which a number of dead or dying insects are usually found entrapped, the product of their decay being assimilated by the plant.

Pinguicula vulgaris. Butterwort. (*Lentibulariaceae.*) A bog plant, indigenous to the British Isles, furnished with radical leaves of a sensitive character. Stimulated by the presence of proteid bodies, the lvs. close over, when the sessile glands secrete a ferment and digest their prey.

Sarracenia, several spp. Side-saddle Flower. (*Sarraceniaceae.*) Marsh plants of N. America, the leaf-petioles of which are modified into erect, often brightly coloured pitchers, each of which is surmounted by a lid formed by the small lamina. These, like other leaf-pitchers, usually contain a quantity of water in which flies and other insects are captured and drowned, and from these their captors derive nutriment.

Utricularia, several spp. Bladderwort. (*Lentibulariaceae.*) Water- or bog-plants, without roots, found in swamps of most countries; some nine species are indigenous to Ceylon. The lvs. are furnished with small bladders, with a trap-door entrance, and thus capture small crustacean animals.

MYRMECOPHILOUS OR ANT-PLANTS

These plants are furnished with cavities or other adaptations for attracting and protecting ants for mutual benefit (*symbiosis*).

Acacia Hindsii. (*Leguminosae.*) A small tree, indigenous to Central America. The hollow, formidable spines are generally inhabited by ants.

Acacia sphaerocephala. Bull's Horn Acacia. Similar to preceding species.

Cecropia peltata. (*Urticaceae.*) Trumpet Tree of Trop. America. Hollow internodes often inhabited by ants; also used by natives for making musical instruments. See *Fibres.*

Coccoloba, several spp. (*Polygonaceae.*) Small trees, mostly of Trop. America and the W. Indies. Hollow stems usually occupied by ants.

Cuviera, several species. Trop. Africa. Hollow swellings on stems inhabited by ants which gain admission by an entrance just above the node.

Duroia hirsuta. (*Rubiaceae.*) S. America. The hollow stems are furnished with entrances into which colonies of ants gain admission.

Humboldtia laurifolia. Gal-karanda, *S.* A small shrubby tree, indigenous to Ceylon and S. India, with hollow internodes which are generally inhabited by ants, entering by a small aperture at base of internode.

Hydnophytum montanum and other spp. (*Rubiaceae.*) Epiphytic plants, indigenous to Malaya, etc., remarkable for their large, tuberous, woody base, which is hollow and provides a home for ants.

Muehlenbeckia platyclada. (*Polygonaceae.*) A scrambling shrubby climber with hollow internodes, indigenous to the Solomon Islands. See *Fol. Shrubs.*

Myrmecodia Beccari and other spp. (*Rubiaceae.*) Epiphytic plants with a hollow tuberous base, indigenous to Malaya, commonly inhabited by ants.

Triplaris surinamensis. (*Polygonaceae.*) A tree of Surinam, the young stems and branches of which are hollow and usually occupied by ants.

SACRED TREES AND PLANTS

The worship of certain trees, supposed to be possessed of spirits, has at all times been practised in many parts of the world, and the custom still survives among many races or religions in various tropical countries. In India and Africa especially, there are many such trees, and these are regarded as objects of veneration or esteemed as emblems of some special virtue. Thus, the Coconut Palm is venerated in parts of the Pacific Is. as an emblem of fertility, while certain varieties of the Oil Palm are regarded as sacred in W. Africa and yield a "holy" oil. Others are held to be possessed of a soul or the spirits of ancestors, *e.g.* the Baobab Tree (*Adansonia*) of Cent. Africa. Sacred Trees are not always chosen for their utility. Shrines for the offering of prayers with flowers, etc., are commonly erected in India and Ceylon under the Bo Tree (*q.v.*). Such offerings usually consist of sweet-scented flowers, as those of Plumeria, and aromatic or fragrant leaves, *e.g.*, the "Sacred Basil." The following are well-known "sacred" species :—

Ficus religiosa. Bo Tree; Peepul; Aswatha, *S*; Aracha, *T.* (*Urticaceae.*) The most sacred tree of India and Ceylon, being venerated by Buddhists as well as Hindus. Devout worshippers will not cut or injure the smallest seedling or branch of this tree. The specimen at Anuradhapura, Ceylon, is probably the oldest historical tree in the world, having been brought from India as a young plant in 288 B.C. When a Bo Tree is in a dangerous position, or seedlings grow spontaneously, as they frequently do, in the crevices of buildings, bridges, etc., a non-Buddhist person must be found to deal with the offending tree or plant. The tree is practically of no economic, and of little ornamental, value.

Bombax spp. Conspicuous trees, several species of which are venerated in Cent. Africa.

Butea frondosa. Palas or Parasu. A small or medium-sized tree, especially sacred to the Brahmins in India. See *Flowering Trees.*

Kigelia pinnata. Sausage Tree. A large, spreading tree with large, curious gourd-like fruits, indigenous to Trop. Africa, in parts of which it is held sacred by the natives. See *Orn. Fol. Trees,* etc.

Melia Azedarach. Persian Lilac; Bead Tree. A small ornamental tree with bipinnate or tripinnate lvs. and small ovoid fruits, native of Persia, etc.; commonly cultivated in India, the fls. being esteemed for thank-offerings.

Nandina domestica. Nandin; "Sacred Bamboo" of China. An erect shrub with bipinnate lvs. and numerous bamboo-like stems, producing panicles of creamy fls. followed by red berries; native of S. China, and much esteemed in that country as well as in Japan for use at temples. See *Foliage Shrubs*.

Nyctanthes Arbor-tristis. Sepala or Sepalika, *S*; Night-flowering jasmine. (*Oleaceae.*) A small tree of Cent. India. The fls. are used in Hindu worship as votive offerings.

Ocimum sanctum. Sacred Basil; Tulsi. (*Labiatae.*) A herbaceous perennial, 2–3 ft. high, one of the most sacred plants to the Hindus. It is found near every Hindu house throughout India.

Phyllanthus Emblica. A small tree, said to be much worshipped in N. India.

Stereospermum xylocarpum. "Padri Tree" of India.

Sterculia colorata. Malaiparutti, *T*. (*Sterculiaceae.*) A handsome flowering tree, indigenous to the dry region (Eastern Province) of Ceylon. The aborigines (Veddahs) of Ceylon sing odes to it. (Trimen.)

Plumeria acutifolia. Temple Tree. Commonly planted near Buddhist temples in Ceylon, the highly scented fls. being greatly esteemed as temple offerings. See *Flowering Trees*.

Prosopis spicigera. Sami Tree (= Sacred Tree). (*Leguminosae.*) A small tree, said to be sacred to the Hindus, especially in N. India.

Nelumbium speciosum. Sacred Lotus; Nelumbo; Nelun, *S*; Tamarai, *T*. This has been held sacred by the Egyptians from time immemorial, and is also venerated in parts of India, Burma, Ceylon, China, etc. See *Water Plants*.

CHAPTER XXXIII

ENEMIES AND FRIENDS OF GARDENS AND ESTATES

(1) *VERMIN AND OTHER ENEMIES.*
(2) *FRIENDS OF PLANTER AND GARDENER.*
(3) *NOXIOUS WEEDS.*
(4) *PRINCIPAL WEEDS OF CEYLON.*
(5) *SOME NOXIOUS WEEDS OF OTHER COUNTRIES.*

ENEMIES

Besides destructive insects, there are numerous animal pests or vermin which the planter or gardener may have to contend with in the tropics, of which the following are some examples.

Squirrels.—These are frequently very destructive to fruit crops, often doing considerable damage to cacao pods, mango fruits, pineapples, etc., and sometimes even to seeds in nursery beds or boxes. Shooting and scaring them away are about the only practical remedies, unless recourse be had to poisoned baits, which is generally risky.

Rats are often very destructive, especially to fruit and root-crops, sometimes to timber trees and coconut palms, eating the tender bark of the former and destroying the young nuts of the latter. Trapping and placing baits poisoned with arsenic are perhaps the only practical ways of dealing with them, but special care is necessary in dealing with poisoned baits. Rats may be prevented from climbing coconut palms and other trees by nailing a collar of tin, about 10–12 in. wide, to the trunk.

Hares sometimes do considerable damage in a garden. A fence of close wire-netting is the best protection against them, while shooting, and hunting with dogs may also be adopted. A low temporary fence of palm leaves or other material will often scare hares and thus serve to some extent as a preventive.

Civet- and **palm-cats** are often destructive to edible fruits, especially pineapples. Watching for them at night and shooting them with the aid of a lamp is perhaps the most practical remedy. The glare of a lamp lures these animals, whose eyes glisten in the reflected light and offer a good target.

Deer or **elk** sometimes do a great deal of damage, especially in the hill districts, by barking trees or browsing on all tender plants that come within their reach. A substantial wire-fence of about six strands serves as a barrier against them.

Porcupines are among the worst animal pests, more especially of up-country gardens. They root up bulbs and tubers of every description, sometimes doing serious damage in a single night. Poisoning and trapping are the usual methods adopted for their destruction, though these appear to be seldom effectual. Spring-guns are sometimes effective, and answer the purpose when the above methods fail.

Wild pig is a very destructive animal in some localities, especially to young rubber and other plantations, as well as root-crops, such as Cassava, Yams, etc. Barbed-wire fencing around the field and shooting the animals are about the only effective remedies.

Cattle.—Trespassing cattle are in many places a most troublesome nuisance. A close double hedge of some thorny shrub (see *Barrier Hedges*) may afford some protection against them, though nothing short of a barbed-wire fence or a solid wall forms a complete barrier. Impounding when caught trespassing may tend to greater vigilance on the part of the owners.

Elephants sometimes commit serious depredations on plantations, especially on young clearings, by pulling up or trampling down the plants. Even isolated buildings and gardens are not safe from their attacks. A close barbed-wire fence is the best deterrent.

Flying-Foxes. (*Pteropus Edwardsii.*) These are often an annoyance in the tropics. They commit their depredations on ripening or fleshy fruits by night, and usually do a considerable amount of damage to the foliage of trees which they inhabit, often entirely defoliating these. A net seems to be the only safeguard against them. Frequent firing at them with a gun scares them away for a time. In Queensland it is reported that poisoned fruit-baits (with strychnine) have resulted in destroying large numbers.

Crows are sometimes formidable enemies to bulbs and certain young plants, as well as to young chickens. The usual protective means is to shoot one occasionally and hang it up where it is desired to scare others. When they occur in large numbers it is best to get at the source or rookeries, *i.e.* where they breed, and destroy them by shooting or by poisoned baits. It may sometimes be necessary to protect plants or seeds against them with a net. Likewise a chicken-run should be covered with a wide-meshed wire-netting. A method sometimes adopted in California to prevent crows from attacking tubers or seed, is to dip these in very dilute tar before sowing.

FLYING-FOXES (*Pteropus edwardsii*).
Suspended in the fierce sun by their feet from every branch after defoliating the tree, appearing like a crop of fruit.

FLYING FOXES ON THE WING.

Grain-feeding birds.—Among these, sparrows are perhaps the most destructive. They have a special fondness for tender annuals, and in a short time will do considerable damage by demolishing young seedlings. Stringing the seed-beds or rows with black cotton has sometimes the effect of scaring them off, but nets are about the only reliable protection. It is sometimes recommended

A GIGANTIC WHITE-ANT (TERMITE) HILL.
Common in parts of Australia and elsewhere in the Tropics.

to dress the seeds, before sowing, with red-lead made into a thin paste with water, or with a form of dilute tar. Ordinary coal-tar, thinned down with kerosene, is sometimes used, drying the seed off with powdered lime. Acetone tar is, however, more effective and safer. Among other grain-feeding birds, the following are the principal species in Ceylon: Weaver Bird (*Ploceus philippinus*); Black-bellied Munia (*Munia malacca*); Spotted Munia (*Munia punctata*); Ceylonese Lorikeet (*Loriculus indicus*); Rose-ringed Parakeet (*Palaeornis torquatus*).

Snails.—An epidemic of what are commonly known as the Kalutara Snail (*Achatina fulica*), introduced to Ceylon and first noticed there in 1910, has spread from the sea-coast to inland districts as far as Teldeniya, Kandy, Nawalapitiya, etc. The snails propagate rapidly in wet weather, laying their eggs under the surface soil in clusters of 200–300 or more. They cover tree-trunks, walls, bridges, etc., by thousands, devouring vegetable crops and stripping the leaves or bark off ornamental plants. They crawl up coffee bushes and feed on the rind of ripe berries (Holland).

Among the few plants they do not seem so far to attack are Roses, Tomatoes, Salvia, Torenia, Coleus, and Caladiums. The snails in all stages, as well as their eggs, should be collected and destroyed. The soil, where they abound, should be frequently turned over and kept as free as possible from weeds. A sprinkling of dry ash on the ground around the crop is a deterrent, and contact with copper sulphate is rapidly fatal to them. Lime appears to be rather beneficial than otherwise to them, for they may be seen crawling up mortar walls in swarms. Mr. Bemelmans recently drew attention to a natural parasite on these, viz. the grub of the fire-fly, which destroys them in large numbers. Therefore these grubs should be encouraged to multiply wherever found. I have been informed that pounded snails and their shells

SECTION OF A PLAGUE OF SNAILS (*Achatina fulica*) ON A CONCRETE BRIDGE IN CEYLON.
A recently imported pest.

make a good flesh and lime diet for poultry. The Buddhist religion, which forbids the destruction of life, does not tend to keep the pest in check.

Lizards are sometimes supposed to cause damage by eating young seedlings, but I am unable to confirm this. Green, late Govt. Entomologist, Ceylon, considered lizards beneficial rather than otherwise in a garden, "as they feed mainly on beetles, grubs, etc." (See p. 447.)

Thieves.—Unlike the other pests named, the depredations of these are not always confined to edible products, but may include anything movable. Catching them in the act and inflicting a suitable punishment is not, unfortunately, always an effectual deterrent. Fruit crops especially, such as coconuts, cacao, etc., are liable to attack by night thieves, and the employment of night-watchers is therefore imperative. Dried coconut leaves, pleated and tied round the stems, make a loud rustling noise should a person attempt to climb the trees, and so give a warning of the presence of pilferers. Probably the greatest obstacle to fruit-growing in the tropics is the difficulty of protecting the crops from thieves.

Fires, caused either by carelessness, neglect, or wilful mischief, often do a great deal of damage to plantations, especially when the latter border on jungle or uncultivated land containing dry undergrowth. Precautions should therefore be taken against these on the approach of a dry period or season. A strip of ground about 12 ft. wide should, where such danger exists, be cleared round the plantation, removing and burning all inflammable material. Similarly, any dried leaves or grass in the vicinity of crops should be collected and burned under responsible control, or buried.

GARDEN AND ESTATE FRIENDS

Injurious insects, fortunately, have natural enemies which under normal conditions usually keep them in check, thus maintaining a balance of nature. These should be encouraged, and may sometimes be successfully introduced when not already present. The following are among the worst enemies of insects, and therefore the best friends of gardens and plantations.

Insectivorous birds.—These play an important part in the prevention of insect pests by feeding on grubs, caterpillars, etc. It has been estimated that one bird, on an average, will consume at least 50–100 caterpillars a day. Green gives the following as among the more useful insectivorous birds in Ceylon :

The Common Hawk-Cuckoo (*Hierococcyx varius*) ; Blue-tailed Bee-eater (*Merops philippinus*) ; Black Drongo (*Buchanga atra*) ; Grey-headed Fly-catcher (*Culicicapa ceylonensis*) ; Magpie Robin (*Copyschus saularis*) ; Grey-backed Titmouse (*Parus atriceps*) ; Ceylonese White-eye (*Zosterops ceylonensis*) ; Ceylon Myna (*Acridotheres melanosternus*) ; Black Crow (*Corvus macrorhyncha*). The last two may often be seen on cattle and helping to rid them of biting flies and ticks. The scarcity of bird-life in planting districts of Ceylon, especially at the higher elevations, has often been commented upon, being attributed, among other causes, to the felling of extensive tracts of forest land for growing crops. One of the best means of encouraging bird-life is to extend the growth of trees or shrubs which produce fruit for bird-food, such as *Aberia* (Ket-embilla), *Antidesma*, *Bridelia*, *Duranta*, *Eugenia* (different species), *Stillingia sebifera* (Tallow Tree), *Ficus* (several species), Guava, Lantana, Mulberry, *Debregeasia* (Gas-dul), etc.

Carnivorous insects.—In maintaining the balance of insect life in nature, there occur in different countries various insects of carnivorous habits, and these may usually be regarded as the friends of the cultivator. Among those well known are the lady-bird beetles (*Vedelia*), which live on scale-bugs, etc.

Pollinating insects.—In the cultivation of fruits and flowers bees and other insects play an important part ; they carry the pollen from one flower to another, or from anther to stigma of the same flower, thus effecting fertilisation or cross-fertilisation. A large number of plants are partly or wholly dependent on such insects for their fertilisation and, therefore, for the production of seeds or fruit. Thus the successful cultivation of the Smyrna Fig, which is dependent on a wasp (*Blastophaga sp.*) for the fertilisation of its flowers, was rendered possible in California only by the introduction of this insect, the trees having previously been barren. (See p. 271.)

Insects as weed-destroyers.—Certain insects, as species of Coccids, may in some cases prove a valuable check on the spread of certain pestiferous weeds, and these sometimes confine their tastes to definite species of plants. Thus *Dactylopius indicus*, when present in large numbers, has been found in Ceylon practically to destroy a species of Prickly-pear (*Opuntia monocantha*), while leaving alone the similar plant *O. Dillenii*. The allied insect, *D. tomentosus*, on the other hand, is said to affect *O. Dillenii* only, and has been found to destroy this in large quantities in Queensland.

Frogs and Toads are most useful creatures in the garden, for they destroy in large numbers many injurious insects. In Europe and America, toads are often specially protected and encouraged to multiply for the purpose of consuming beetles, snails, wire-worms, weevils and other destructive insects. The value of toads in gardens is well recognised, and they are sometimes in demand for colonising purposes.

Lizards of all sorts are considered beneficial as well as interesting creatures in a garden. They feed mainly on beetles, grubs, etc., and therefore should be encouraged to multiply. (See p. 446.)

Rat-snakes may be regarded as somewhat of a mixed blessing, most people having a repulsive feeling against all snakes. Yet rat-snakes in particular, which are not poisonous, are a common enemy of rats and other vermin.

NOXIOUS WEEDS AND THEIR CONTROL

Weeding, or the destruction of weeds, enters largely into the economy of garden and estate work in the tropics. A weed is generally defined as "a plant out of place" ; thus, though a wider definition is required, a plant which may otherwise be useful may in certain circumstances become a weed. Any plant deemed a weed in a garden should, of course, be suppressed as far as practicable ; but on estates the proper degree of weeding and the best system of carrying it out are disputed points. For perennial crops, many planters believe in some degree of clean-weeding, while others, for reasons of economy or soil preservation, adopt a more moderate or partial form of weeding combined with tillage. It is reasonable to suppose, however, that rank weeds do compete with crops for light and air as well as for the available plant-food in the soil, while they may also harbour insect pests and possibly parasitic fungi.

Weeds are usually provided with rapid means of natural distribution, their numerous seeds being readily carried either by wind or water or by animals ; or their tuberous roots may be of a prolific and persistent character, rapidly multiplying underground, e.g. *Oxalis* or Manickwatte Weed. Manure and grain crops are frequent carriers of weeds, while even man may sometimes unconsciously be the means of introducing a serious pest when importing ornamental or curious plants. Neglected vacant ground often becomes a harbour of pestilential weeds and a danger to neighbouring plantations or gardens. Weeding becomes less necessary as crops cover the ground, and in the case of Rubber or other trees which almost entirely cover the ground, it may be very considerably curtailed. The growing of green-manure or cover-crops (see p. 25), or raising suitable annual between perennial crops, as in the case of Rubber and Coconuts, during the earlier years of their growth have the effect of minimising weeding, in addition to enriching the soil or providing interim returns. Where this is not practicable, at least a clear space should be maintained free of weeds around each tree or plant, the space varying according to the size of the latter.

Weeds may sometimes serve as a ground-cover, preventing excessive surface-

wash or erosion, e.g. *Oxalis* on steep hill-sides up-country. On the other hand, the operation of weeding on flat or sloping land may also serve a useful purpose in that it ensures tillage and aeration of the soil, while the weeds thus removed may often be advantageously utilised as a mulch. The Lantana-weed, which occupies extensive areas of waste or poor land in Ceylon, has been found to have the effect of opening up the soil with its roots and enriching it with humus. Therefore weeds have sometimes redeeming qualities.

On estates in Ceylon, the usual system of performing the weeding is to lease out certain areas on contract to the kanganies (headmen of the labour force). The amount paid depends on local conditions and the nature of the crop; thus Rs. 1.50 to Rs. 2 per acre a month is about the usual contract price for weeding established Tea fields, but in a weedy locality or on new clearings it may be as much as Rs. 4 to Rs. 5 or more per acre. It is estimated that the average cost of weeding Tea in Ceylon ranges from 3 to 4 cents (½*d.* to ⅝*d.*) per lb. of made tea. All this, of course, has had to be considerably modified owing to the recent economic depression.

An excellent method, though not always capable of application, of overcoming noxious weeds, is to grow in the affected ground some quick-growing annual crop which forms a dense ground-cover, the weeds thus becoming choked out. Any close- and quick-growing plant obtainable in sufficient quantity will answer the purpose, though it should by preference be of the leguminous family. (See *Green Manuring.*)

The first principle in controlling weeds is to prevent their seeding. But there are some weeds which are not solely dependent upon seed for their reproduction, as the Illuk- or Lalang-grass (so troublesome in Malaya), and the Oxalis in up-country districts in Ceylon, which is reproduced chiefly by small tubers. Therefore, in dealing with these, recourse must be had to starving out the roots by persistently cutting down the leaves, which at the same time prevents, of course, the plants from seeding. This method is effectual in exterminating persistent weeds, as the Sensitive Plant (*Mimosa pudica*) and the Mexican Sunflower (*Tithonia*), which is troublesome in Ceylon along railways. The same effect may be obtained by placing a layer of Maana-grass or other covering over the affected ground. An old adage, which emphasises the importance of preventing weeds from seeding, runs:

One year's seeding,
Is seven years' weeding.

In some cases, as in Coconut cultivation, it is possible to keep weeds under control by means of grazing cattle, which at the same time benefit the palms by their manure. (See p. 422.) These may have the effect not only of suppressing rank weeds, but also, if not too numerous, of forming a close sward.

Poison weed-killers.—The application of these is not usually practicable among cultivated crops, except perhaps on new clearings or when the crops are in a young state and with sufficiently wide interspaces. Commercial weed-killers usually contain certain poisons, and may be either in powder or liquid form. Those with a proportion of arsenic, carbolic or sulphuric acid, etc., are the most effective, but they have to be used with great caution, owing to their highly poisonous character. Others at less risk and smaller cost may be made up of washing soda, kerosene, boiling water, etc. Common salt is sometimes used alone in a 10% solution, say, 1 lb. to a gall. water per 5 sq. yards. (See *Salt.*)

Arsenite of Soda is sometimes employed for deep-rooted weeds or scrub, or for roads, railway tracts, tennis courts, etc. Formula: dissolve 1 lb. arsenic and 2 lb. washing soda in 10 gall. boiling water. Apply at the rate of ¼ gall. to the square yard. In using this or other poisonous weed-killers care should be taken to prevent contact with one's skin or clothes, and the mixtures should be applied with a water-can and a fine rose.

Arsenic trichloride in a gaseous form is reported to be used with much success in exterminating the Prickly Pear (*Opuntia*) in Queensland. It is applied by means of an "atomiser," and is said to be comparatively harmless to other plants, owing

to their water content being much lower than that of the Prickly Pear and similar succulent plants.

Weeds on lawns. To rid lawns of weeds by hand is tedious work and is seldom satisfactory. Treating the lawn with sulphate of ammonia, either in the dry powdered state or dissolved in water in the proportion of ½–¾ oz. to the square yard, has the merit of serving a double purpose, for whilst it checks the growth of coarse weeds it promotes the production of fine-leaved grasses. In the case of large-leaved or deep-rooted weeds, as *Elephantopus*, a pinch, just enough to fill a salt-spoon, dropped into the centre of the weed will soon kill it. (See *Lawns*; also *Fertilisers.*)

Aquatic Weeds. Large or deeply submerged weeds are best overcome by dragging, or by draining off the water and starving the pest. Surface weeds or scum can sometimes be destroyed by a solution of copper-sulphate. Break up the sulphate (1 lb. to every 100,000 gall. of water) and enclose in a bag of loose texture. Tie this behind a raft or boat and draw backwards and forwards through the water in parallel strips about 10 ft. wide. The sulphate will thus become dissolved and kill the weeds, which will sink and disappear. It will do little or no harm to any fish that may be present. (See *Water Hyacinth.*)

PRINCIPAL WEEDS OF CEYLON

Those Marked * are introduced.

Adiantum cuneatum. Maiden-hair Fern. Up-country, among Tea, etc.

Ageratum conyzoides. Hulantala, *S*; Pum-pillu, *T*; Goat-weed. Annual, with strong, objectionable odour; all elevations. See *Med. Plants.*

Aloe vera, var. littoralis. Katalai, *T.* (*Liliaceae.*) Dry region, sea-coast.

Amarantus spinosus. Kalu-tampala, *S.* (*Amarantaceae.*) Semi-dry region.

Aponogeton crispum. Kekatiya, *S.* A water weed, chiefly up-country.

Artemisia vulgaris. Wal-kolondu, *S.* (*Compositae.*) Erect perennial with deeply pinnatisect aromatic lvs., resembling Chrysanthemum in young state. Waste places, medium to high elevations. **A. Roxburghii.** Similar to latter species, 5–7 ft. high, commonly used as temporary hedges round coolies' gardens up-country.

Bidens pilosa. Wal-té-kola, *S*; Spanish-needle. (*Compositae.*) Throughout moist region, in cultivated ground.

Blumea membranacea. (*Compositae.*) Annual, 5–6 ft. high. Up to 4,000 ft.

Cardamine hirsuta. Kadavi, *T.* (*Cruciferae.*) Up-country, small annual.

Cassia mimosoides. Bin-siyambala, *S.* (*Leguminosae.*) Annual, 2–3 ft., resembling Sensitive Plant. Throughout tropics; low-country, waste ground.

***Chenopodium ambrosioides.** (*Chenopodiaceae.*) An erect perennial, 2–3 ft. high, with strongly aromatic, pointed, segmented lvs., common at medium and high elevations. First noticed in Ceylon in 1882. (Trimen.) See *Essential Oils.*

Cuscuta chinensis. Dodder. Aga-mula-neti-vel, *S* (= "a creeper without beginning or end"). *Convolvulaceae.* A parasite on grass, shrubs., hedges, etc., forming a tangled mass of pale yellowish stems without lvs. Common in Tropics, up to about 2,000 ft., often on Mikania-weed in Ceylon. The only remedy is to cut down and burn all affected growths.

Cyperus rotundus. Kalanduru, *S*; Kora, *T*; Nut-grass. (*Cyperaceae.*) A low sedge with numerous underground, edible tubers, found at all elevations in moist region, often as an obnoxious weed. The only way to eradicate it is by digging up the tubers. "The most troublesome weed in Bengal" (Watt).

Drymaria cordata. Kukulu-pala, *S.* *Caryophyllaceae.* Erect annual, 1–1½ ft., widely distributed, common up-country in waste ground. Has been recommended as a ground-cover.

Elephantopus scaber. Et-adi, *S*; Elephant's Foot. (*Compositae.*) Low-country, lawns and pastures. Trop. Asia.

Erigeron sumatrense. Alavanga-weed. (*Compositae.*) Annual with erect stems, 5–6 ft. From medium to high elevations.

***Eryngium foetidum.** Stink-weed; Fit-weed. (*Umbelliferae.*) Herbaceous annual of Trop. America, with foetid, prickly lvs.; among grass in moist shade. Peradeniya, Kandy, etc.

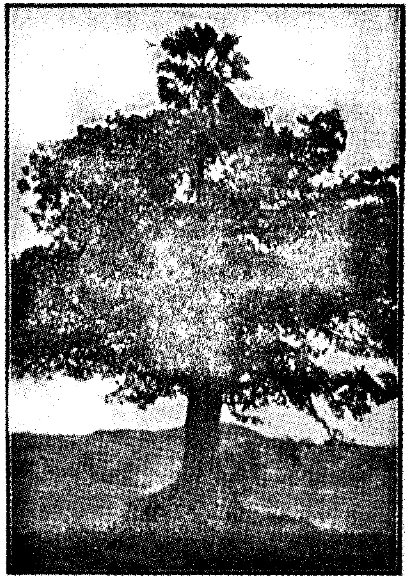
Euphorbia hirta (= **E. pilulifera**). Bu-dada-kiriya, *S*; Palavi, *T.* Small annual in cultivated ground. See *Medicinal Plants.*

Ficus parasitica. Gas-netul, *S.* An epiphyte in young state, growing in the forks of trees or on the stems of palms; frequently surrounds its host and becomes a tree with spreading branches. In the accompanying illustration it has almost completely surrounded a Palmyra palm, only the crown of which is seen remaining at the top.

***Galinsoga parviflora.** (*Compositae.*) Small annual of Peru, 10–15 in. high; waste ground up-country.

***Gnaphalium multicaule.** Wild Mignonette. (*Compositae.*) A perennial, 1½–2 ft.; up-country, introduced to Ceylon about 1880. (Trimen.)

Hydrilla ovalifolia, for some time known as "Colombo Lake weed," which at one time turned the Colombo Lake into an unsightly mass of weed, causing a plague of flies, being kept in check by constant dragging, at considerable expense to the municipality. It is a pestiferous plant in lakes and ponds, and for some years formed a dense mass in the pond in Peradeniya Gardens. It suddenly disappeared in 1916 owing, it is surmised, to the introduction of the gourami fish of Java, which are greedy feeders on water-weeds.



Ficus parasitica.

An epiphytic creeper which first took root among the leaves of a Palmyra Palm, afterwards forming a tree round its host (indicated by an arrow), which is now almost completely enveloped by its enemy.

Imperata arundinacea. Illuk, *S*; Lalang of Malaya. Erect grass, 3–4 ft. high, often a pest at low elevations, generally in badly drained, sour, or neglected land. Difficult to eradicate when once established. The strong rigid lvs. make good thatch. See p. 448.

***Lagascea mollis.** (*Compositae.*) Annual of Cent. America. Introduced to Ceylon in 1852; a common weed in low-country, especially near sea-coast.

***Lantana aculeata** (*q.v.*). Katu-hinguru, *S*; Lantana-weed. (*Verbenaceae.*) Prickly, slender sh., 5–8 ft. high, up to about 4,000 ft., especially in semi-dry districts. Perhaps the most familiar plant in Ceylon, introduced about 1826 as an ornamental plant. A weed in waste or neglected ground only, up to 5,000 ft.

Leucas zeylanica. Tumba, *S.* (*Labiatae.*) Low-country, waste ground.

Limnanthemum indicum. Olu or Maha-ambalu, *S.* Water-weed with floating, round lvs., resembling those of *Nymphoea*. Ponds and streams.

Loranthus. Bird-vine; Pililla, *S*; Kuruvichai, *T.* (*Loranthaceae.*) Semi-parasitic on trees and shrubs, like mistletoe. Distributed by birds, which carry the viscous seed and deposit it on branches, where it germinates and takes root. Only remedy is to lop off and burn the affected branches. 6 species are indigenous to Ceylon low-country, 3 to up-country, and 3 to the dry region.

***Mikania scandens.** Mikania-weed; Loka-palu, *S* (= "World-ruin"); "A mile-a-minute" (Malaya). (*Compositae.*) A quick-growing and rapidly spreading herbaceous climber, native of Trop. America. Low-country and up to 4,000 ft. Also a scourge in S. India, Malaya, Fiji, etc. (See fig. opposite). The parasite *Cuscuta* (see p. 449) may become a natural check on it.

***Mimosa pudica** (*q.v.*). Sensitive-plant; Nidi-kumba, *S.* (*Leguminosae.*) Introduced from Brazil before 1804. Stems thorny, creeping; lvs. small, bipinnate, very sensitive, closing immediately on being touched or in rain. Often a troublesome weed in pastures, neglected lawns, etc. Low-country and up to about 4,000 ft. Root used as an antidote for cobra-bite.

Nymphoea stellata. Manel, *S*; Water-lily. (*Nymphaeaceae.*) Common in ponds, tanks, etc., especially in low-country, often to the exclusion of all other plants. Difficult to eradicate when once established. Fls. pale blue.

***Opuntia Dillenii.** Katu-patuk, *S*; Naka-kalli, *T*; Prickly Pear. (*Cactaceae.*) Sharp spines, 3–5 in. long, in bunches. Sea-coast and dry region, chiefly Jaffna district; used as a barrier hedge. ***O. monocantha.** S. Province. Similar to latter species; spines usually single, especially on older portions (Petch.) See *Cacti*, also p. 447.

Principal Weeds in Ceylon.

1, Goat Weed (*Ageratum conyzoides*); 2, Prickly Pear (*Opuntia Dillenii*); 3, Fruit of Prickly Pear; 4, Lalang or Illuk (*Imperata arundinacea*); 5, Alavango- or Crowbar-Weed (*Erigeron sumatrense*); 6, Musal-katha, *T* = Hare's Ear (*Sonchus arvensis*); 7, Loka-palu, *S* (*Mikania scandens*); 8, Koray, *T* (*Cyperus rotundus*); 9, Couch-grass (*Panicum repens*); 10, Manickwatte Weed (*Oxalis latifolia*); 11, Lantana Weed (*Lantana aculeata*); 12, Kurunegala Daisy (*Tridax procumbens*).

***Oxalis corymbosa.** Manick-watte Weed; Embuldeena, *S.* (*Geraniaceae.*) Tuberous stemless perennial, with fleshy, trifoliate basal lvs. 6–10 in. long. Between 3,000 and 5,000 ft., in cultivated ground, especially in wet region. Leaflets rounded; fls. pink. Spreads rapidly by means of numerous, small, underground tubers. Native of S. United States, introduced before 1824. Though an uncontrollable weed in some districts, on steep slopes it may be a useful check on soil erosion. ***O. latifolia.** Distinct from the latter by the triangular leaflets, but similar in habit, etc. More common than former species about Nuwara Eliya.

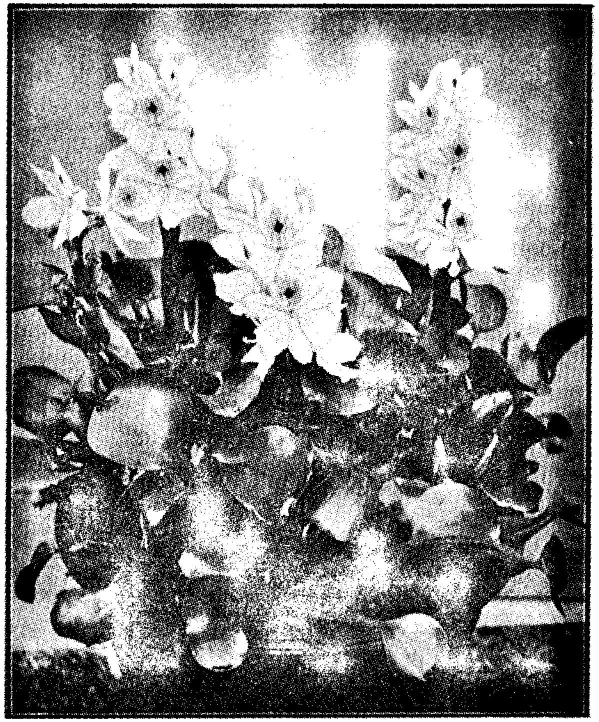
Polygonum punctatum. Snake-weed. (*Polygonaceae.*) Semi-creeping, deep-rooting weed; hill districts up to 6,000 ft. Pink fls.

Portulaca oleracea. Genda-kola, *S*; Pulik-kirai, *T.* (*Portulaceae.*) Dwarf, creeping herb; low-country, cultivated ground.

Panicum repens. Couch grass; Etora, *S.* Low, deep-rooted, persistent grass, chiefly at medium and high elevations. See p. 425.
Solanum indicum. Tibbatu, *S.* Shb., 1–3 ft., fls. purple; waste ground.
***Sonchus arvensis.** Sow-thistle; Musal-katha, *T.* (*Compositae.*) In stony, gravelly ground and crevices of walls, etc.; chiefly medium elevations.
***Synedrella nodiflora.** (*Compositae.*) An annual of Mexico. Waste ground, moist low-country; Peradeniya, etc.
Tithonia diversifolia. See p. 112, etc. Ornamental herbaceous plant, 6–7 ft. high, growing in continuous mass, spreading by rhizomes as well as seed. Introduced to Ceylon in 1851, now a common weed along roadsides, railways, river-banks, etc., up to 4,000 ft.
***Tridax procumbens.** Kurunegala Daisy. (*Compositae.*) Low and medium elevations, chiefly dry districts. Native of S. America.

SOME NOXIOUS WEEDS OF OTHER COUNTRIES

Amarantus spinosus. Ann., 4–5 ft. high, whole plant spinous. Hawaii, etc.
Carduus arvensis. Californian or Canadian Thistle. (*Compositae.*) N. America.
Clidemia hirta. Koster's Curse. (*Melastomaceae.*) Fiji.
Cryptostemma Calendulaceum. Cape-weed. (*Compositae.*) A troublesome weed in N. South Wales, E. Africa, etc. Native of S. Africa.
Cynodon Dactylon. Bermuda-, Bahama-, Wire-, Doob-, Devil's Grass, etc. (*q.v.*). Though a useful lawn- and fodder-grass, it is a troublesome weed in some countries.
Eichhornia (Pontederia) crassipes. Water Hyacinth; Lilac Devil. (*Pontederiaceae.*) Native of Brazil. A floating, troublesome water-weed in Florida, Queensland, parts of Java, Burma, etc., sometimes blocking rivers and waterways. A beautiful plant with erect racemes of bright mauve or lilac fls. The lvs. and bladder-like leaf-stalks are rich in potash and used for manure; they are employed in Malaya for feeding pigs, and in the W. Indies for donkeys, etc. Spraying with white arsenic (arsenious oxide) and arsenite of soda is used in Florida for controlling the pest.



WATER HYACINTH (*Eichhornia crassipes*).
A beautiful plant when in flower, but a formidable pest in some countries.

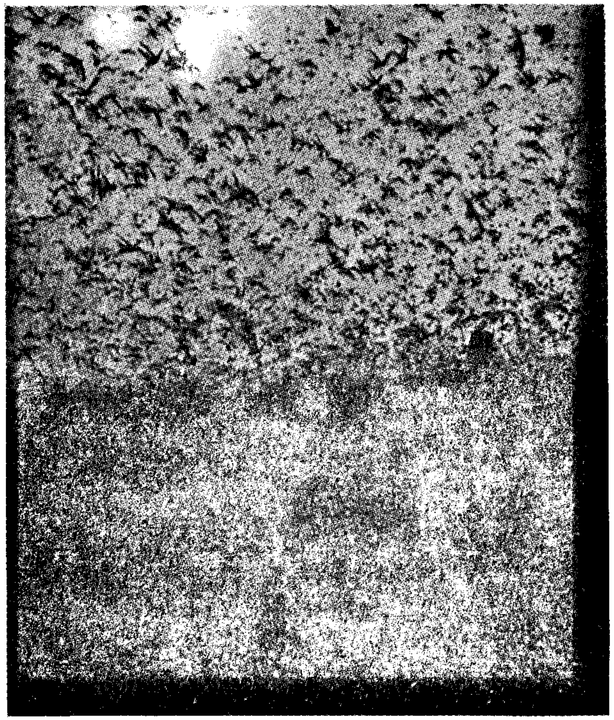
Its cultivation in Ceylon, where it was introduced in 1905 as an ornamental plant, is now prohibited by law.
Erigeron canadense. Cobbler's Pegs. (*Compositae.*) N. South Wales.
Imperata arundinacea. Lalang. Malaya, etc. See p. 451.
Opuntia Dillenii. Prickly Pear. Queensland, N. India, etc. See *Cacti*, etc.
Panicum Curtisii. Maiden Cane. A grass, native of Florida, etc.
Phytolacca sp. Poke-weed. (*Phytolaccaceae.*) N. South Wales, etc.
Pistia (*q.v.*). A troublesome water-weed in Egypt and other flat countries.
Polygonum tomentosum. (*Polygonaceae.*) Ootacamund, etc.
Prosopis stephaniana. A persistent weed in fields or gardens of arid countries, as in S. Persia, Iraq, Syria, etc.
Pteris aquilina. Bracken-fern. N. South Wales, etc. Common in the tropics at elevations of 4,000 ft. upwards.
Sida retusa. Paddy's Lucerne. (*Compositae.*) N. South Wales, etc.
Sorghum halapense. Johnson- or Sorghum-weed. A tall grass. W. Indies, Cent. India, etc.
Tagetes minuta. Mexican Marigold. (*Compositae.*) S. Africa.
Victoria regia (*q.v.*). Giant Water-lily. A beautiful plant, but a troublesome water-weed in British Guiana, being difficult to handle on account of its spiny lvs. and leaf-stalks.
Vittadinia australis. Australian Daisy. N. South Wales, Queensland, etc.
Xanthium spinosum. Bathurst-burr; and **X. strumarium**, Cockle-burr. (*Compositae.*) N. South Wales, etc.

CHAPTER XXXIV

INSECT AND OTHER PESTS

THE extent of the destruction caused to crops by various insect pests in different countries is incalculable, no country being immune from them in some form or another. Some countries, however, are less prone to serious visitations than others. Under normal conditions insects are kept in check by the ordinary balance of nature and the usual struggle for existence. They are subject to natural enemies and disease, and are killed in large numbers by parasites, birds, unfavourable weather and other causes. Parasitic insects take heavy toll of insect life. They lay their eggs on the larvae or eggs of others, and when the young grubs hatch out they live at the expense of their host. Hence the rhyme :

"Big fleas have little fleas upon their backs to bite 'em
And little fleas have lesser fleas, and so ad finitum."



PLAGUE OF LOCUSTS IN ARGENTINA.

By the clearance of forests and the development of extensive areas under plantation or garden crops the normal balance of nature is to some extent upset, and many hitherto harmless insects may rapidly multiply and become serious pests, the conditions for their development having become abnormally favourable.

MECHANICAL CONTROL MEASURES, ETC.

Much may be done by cultural methods, apart from applications of insecticides, to minimise the depredations of insect pests. Burning or burying of prunings is important. If buried, they should be

placed deep enough to ensure against the emergence of any young brood which may be present in the egg form.

Light traps are sometimes used effectually for catching night-flying moths, beetles, etc. An ordinary kerosene lamp with a reflector, hung over a tray containing some sugary substance or jaggery and water, with a film of kerosene, will answer the purpose. Acetylene lamps are thus used in vineyards in Europe.

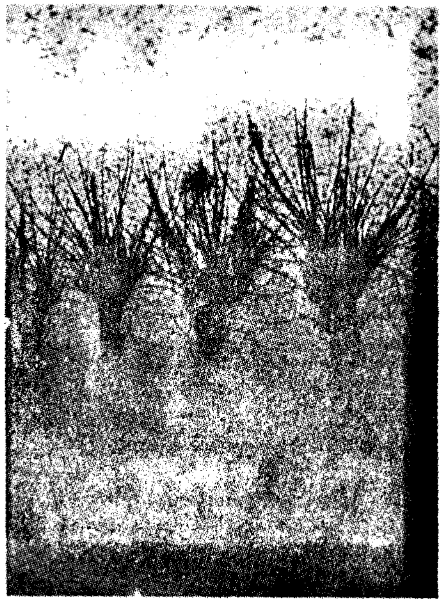
Hand-picking is often effectual in dealing with caterpillars, beetles, etc., these being knocked off by shaking the plant or tapping the branches with a stick over a cloth spread underneath, the insects being then removed or swept up and dropped in kerosene, or burned. A stick with one end smeared with a gummy substance may be found useful for catching certain insects, and hand-nets are indispensable for collecting flying insects.

Insect traps may be formed of any discarded tins or jars sunk level with the ground and containing some sugary substance. Caterpillars, grubs, etc., crawling into these are unable to climb out again, and should be destroyed. Large leaves and pieces of any fleshy tuber laid on the ground serve as traps for grubs and beetles, and should be examined early in the day. Deep trenches with steep sides are also sometimes employed as traps, as for locusts (*q.v.*).

Protective collars are often necessary in up-country gardens to protect tender seedlings from grubs, and may be made of tin, cardboard, or cigarette tins, with the lower end sunk ½ in. under the ground surface. These are removed when the plants have outlived their liability to attack. (See *Black Grub.*)

Trap-crops.—Attacks by insects of an omnivorous nature, as locusts, may sometimes be greatly checked or nullified by raising belts of a quick-growing bait-crop and spraying this with a poisonous insecticide.

Close Season for crops.—In the case of annual crops the rule of "close season" is sometimes enforced, during which no part of the crop is allowed by law to remain in the ground, *e.g.* Cotton in some countries. Certain classes of insects, being thus deprived of their food, are starved in large numbers. **Rotation of crops** (*q.v.*) has a similar effect and should be practised when possible.



SHOWING IMMEDIATE EFFECT OF A VISIT FROM A SWARM OF LOCUSTS.

SOME COMMON INSECT PESTS

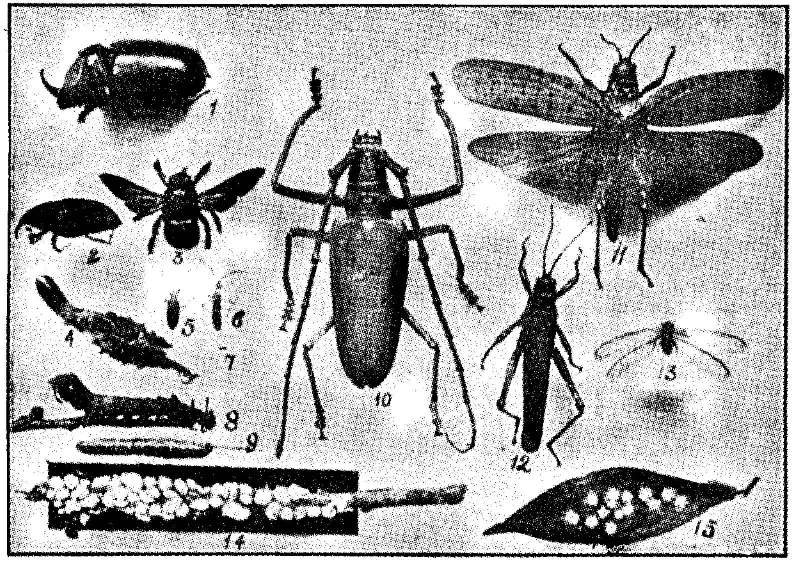
Insect pests may be classed as (1) *Leaf-eating* (*e.g.* caterpillars, beetles, grasshoppers); (2) *Sucking* insects, which puncture the plant tissues and suck out the juices (*e.g.* scale insects, bugs of various kinds, mites, thrips, red-spiders); (3) *Boring* insects, which attack stems, roots, fruits, etc. (*e.g.* boring beetles, weevils). The larvae of butterflies and moths are called *caterpillars*; those of beetles, bees and wasps are *grubs*; and those of flies, *maggots*. The pupa of a butterfly is called a *chrysalis*, and that of a moth *cocoon*.

Cut-worm or **Black-grub.** (*Agrotis ypsilon.*)—A fat, brownish-black caterpillar, 1¼–1½ in. long, which attacks at, or just below, the ground-level almost any young seedlings, especially those of flower or vegetable crops, in up-country gardens. Land reclaimed for garden crops, etc., should be thoroughly cleared of all weeds and under-

growth, and left fallow for about 6 weeks, any grass, weeds, etc., being burned on the surface. An application of freshly-slaked lime, lightly forked in, is recommended.

Locusts. (*Aluchares militaris* and other spp.)—A serious pest in many warm countries, especially in N. and S. Africa, Arabia, Syria, Persia, S. America, etc. The pest is of ancient origin, being a "plague" in Biblical times, and occurs periodically in enormous swarms. The female drills a hole in the ground, in which she lays from 80 to 120 eggs, which take from 16 to 36 days or more, according to temperature and moisture, to hatch.

Control measures of various kinds have from time to time been tried or recommended, including the spraying with sodium arsenite from low-flying aeroplanes, flame-throwing, etc. So far, however, none of these has been quite satisfactory.



Some Insect Pests of Ceylon.

1, Rhinoceros Beetle (*Oryctes rhinoceros*); 2, Red Weevil (*Rhynchophorus ferrugineus*); 3, Carpenter Bee (*Xylocopa tenuiscapa*); 4, Faggot Worm (*Clania variegata*); 5, Red Cotton Bug (*Dysdercus cingulatus*); 6, Paddy Bug or Fly (*Leptocorisa varicornis*); 7, Shot-hole Borer (*Xyleborus fornicatus*); 8, Lobster Caterpillar (*Stacropus mauritia*); 9, Paddy Swarming Caterpillar (*Spodoptera mauritia*); 10, Longicorn Beetle (*Batocera rubus*); 11, Spotted Locust (*Aluchares militaris*), wings open; 12, Spotted Locust (*Aluchares militaris*), wings closed; 13, Termite or "White Ant" (*Calotermus militaris*); 14, Mealy Bug (*Phenococcus iceryoides*); 15, Star or Scale-Bug (*Phenococcus ornatus*).

Among the most practical measures are: Stirring the soil for egg-masses and destroying these; laying poison baits (as bran-mash and arsenic) for the hoppers (*nymphs*) in prepared trenches; erecting barricades of galvanised iron sheets or similar material in order to obstruct the hoppers, which are then destroyed by spraying or burying in deep trenches dug behind the barricades. Quick-growing trap-crops, *e.g.* Castor-oil plant, grown in bolts and sprayed with an arsenic compound or other poison at the season of attack, are sometimes employed with considerable success. Small epidemics of Spotted Locusts occasionally occur in Ceylon in the Matale district. (See *Entomogenous Fungi.*)

Palm Beetles.—The crown or cabbage part of the coconut and other palms is often attacked by large beetles (Black-beetle, Red-beetle, etc.) which disfigure the

fronds and sometimes permanently injure the tree. These may be harpooned or extracted by a stiff piece of wire, or a long hat pin, with a barb at the end, the hole being then filled with fine dry sand. The latter in itself may act as a preventive, disabling the beetles by getting into their joints. Beetles may be caught in large numbers at night by means of a kerosene lamp. (See *Light traps.*)

Eelworms or Nematodes.—A microscopic group of translucent animal-life which infest the ground and often cause considerable injury to plants before their presence is detected. They first attack the roots, which become knotty, bearing small gall- or wart-like excrescences. Tomatoes, cucumbers and melons are especially liable to their attack. Plants badly affected should be removed and burned; the soil should be opened up and treated with Vaporite or carbon bisulphide. Liming the soil and a change of crops are also recommended.

Wireworms.—The larvae of various kinds of beetles, seldom reaching 1 in. in length, which are often a troublesome pest, gnawing the stems and roots of plants just below the surface. They may live in the soil in the worm state for 4 or 5 years, and feed voraciously on the tender roots of almost any plants. Soils that have been long undisturbed, as fallows and pastures, are usually infested; therefore thorough tillage or frequent hoeing is recommended. They may be trapped with slices of raw potato or carrot placed in the ground, these being taken up and examined daily. Vaporite or unslaked lime is also recommended.

Leaf-galls, which are common in the tropics but do not usually cause much harm, are usually due to irritation of the leaf-surface by mites and small insects, causing pockets or blisters. Some trees are more prone to these than others, e.g., *Eugenia malaccensis* and *Canthium didymum.* In the latter the galls closely resemble fruits. (See *Stem and Branch Diseases.*)

Mosquito preventives.—Stagnant water, as often found in drains, roof-gutterings, discarded tins, broken vessels, bamboo stumps, etc., is especially favoured by mosquito larvae for breeding. Moist shade, as under heavy foliage, and plants with water-collecting adaptations, as sheathing leaves or floral receptacles, also offer facilities for the pest, for the breeding of which water is indispensable.

In addition to guarding against these sources as far as possible, free use should be made of a larvicide which leaves a film on the surface of the water, as kerosene. Small fish, such as "millions," are among the principal natural enemies of mosquitoes. As a repellent for mosquitoes, the fumes of burning pyrethrum or other insect-powder are efficacious; while for protecting the body, a mixture of citronella oil (3 oz.), spirit of camphor (1 oz.), kerosene oil (2 oz.), coconut oil (2 oz.), is very effective when rubbed on the skin. Certain species of mosquitoes are carriers of disease to human beings; thus malaria is carried by *Anopheles*, and yellow fever by *Stegomya.*

INSECTICIDES

These are of various sorts and are used according to the habit of the insects and their manner of obtaining their food, as *stomach poisons* (for those which suck juices through their proboscis), *contact poisons, fumigants* (as gas, smoke or vapour), *repellents*, as naphthalene, camphor, etc. Some insects are susceptible to both stomach and contact poison, as soft-bodied caterpillars.

STOMACH POISONS

These are eaten with the plant tissue and kill the insect by absorption through the alimentary system. The following are examples:

Arsenate of Lead.—Formula: Acetate of lead (Sugar of lead), 3 oz.; arsenate of soda, 1 oz.; water to make up to 10 gall. Place the two former in hot water, stir till dissolved, when it is ready for use. 1 lb. treacle may be added to render the mixture more adhesive. This mixture has the advantage of adhering well and does not burn the leaves. Use wooden vessels.

Arsenate of Lime.—As a substitute for the above the following may be used: ½ lb. arsenic, 2 lb. washing soda, and 1 gall. of water. Add one pint of the mixture to 4 gall. of water, and to this add 2 oz. unslaked lime.

Paris Green (Scheel's Green, Mitis Green).—A powerful poisonous compound of

arsenic and acetic acid, having the appearance of fine powder with a clear green colour. For use take : 1 oz. of the powder and mix in 6–8 gall. water ; stir thoroughly, and apply as a fine spray. Regulate strength of mixture according to nature of the plants.

London Purple.—A compound of arsenic and lime, with a certain amount of colouring-matter. For use as a spray the formula is : London Purple, 1 lb. ; lime, 2 lb. ; water, 200 gall. Mix well the two former before adding the water.

CONTACT POISONS, ETC.

These kill by clogging the respiratory organs and are used for insects which obtain their food by sucking juices, *e.g.* plant-bugs, scale insects, etc., and for which stomach poisons would be ineffective. Some may also kill by their corrosive action on the insect's body.

Kerosene emulsion is one of the most effective for scale-insects and bugs, and is made by mixing kerosene with soap and hot water to form an emulsion. For use on a small scale, the following proportions will answer the purpose : kerosene, 2–3 fluid oz. ; soap, 4 oz. ; hot water, 2 gall. Thoroughly churn the mixture with a syringe and apply after sunset or in shade. If the plants are of a delicate nature, use less kerosene and syringe with clear water ½ an hour afterwards.

Resin or **Rosin** enters into the composition of several valuable spray-fluids for different forms of scale-insects. It forms a covering over the insect, thus preventing its breathing. The following formula is recommended : Resin, 2 lb. ; caustic soda, 1 lb. ; coconut oil, 2 pints ; water, 10 gall. Boil the ingredients until the resin is dissolved ; then make up to 15 gall. water. The solution should be diluted with 3 times its quantity of water before using. It is especially recommended for use against Sooty-mould bug on Orange and other Citrus trees. (See *Sooty-mould.*)

Tobacco-juice is often used against thrips, aphides, animal-lice, etc. Take ½–1 lb. of cured tobacco-leaf or waste ; place in 2 gall. of water ; bring to the boil and allow to simmer for a time. The liquid, after being strained may, if not too strong, be used direct for spraying ; otherwise it should be diluted with water until of the desired strength to suit the plants concerned. To render it more effective, about 1 oz. of soft-soap may be added for each gallon. Several commercial preparations of tobacco juice are obtainable.

Hot Water and Soap.—Up to a temperature of 170 or 200° F., hot water with soap will kill certain delicate insect pests, as green-fly, etc., without injuring their host plants. Very hot water, applied forcibly with a syringe, will cool sufficiently between syringe and plant to avoid injury to the latter, though fatal to insect life.

Borer Wash.—For boring beetles attacking the trunk and larger branches of trees, the following wash is recommended : Carbolic acid (crude), 1 pint ; soft-soap 2 lb. ; water (hot), 1 gall. Dissolve the soap in the water, add the carbolic and stir well. Add 6 gall. water and enough clay to thicken the mixture.

FUMIGANTS

Destroying insect pests by means of poisonous fumes, gas, or vapour, commonly termed *fumigation*, is usually adopted for plants growing in or moved into enclosed structures, or for trees or crops in the open with a collapsible air-tight tent placed over them. An essential condition in fumigating, contrary to spraying, is that the foliage must be dry ; otherwise the plants are liable to be injured. The plants should not be watered immediately before treatment, or exposed to the sun for several hours afterwards. Fumigating is best carried out after sunset, unless the plants are in the shade or under cover.

Hydrocyanic gas is, for efficiency and facility of application, the most satisfactory fumigating process yet discovered. The gas is a deadly poison, being fatal to all animal life by inhalation. It is especially effective against scale-insects and and stored grain affected by weevil. It is generated from cyanide of potassium or sodium cyanide with sulphuric acid. An ordinary wardian case with a capacity of about 10 cu. ft. is sometimes used for the purpose at Peradeniya, Ceylon, the proportions of chemicals being : ¼ oz. cyanide of potassium (90%) ; ¼ fluid oz. sulphuric acid ; and ¾ fluid oz. water. All crevices are closed with wet clay to prevent the gas escaping. After the expiration of half an hour, the case is opened and left for several hours. The principle is the same when the process is applied on a larger

scale. In the Colombo fumigatorium the following proportions are used, viz. for every 100 cu. ft. of space : 1 oz. cyanide, 1 fluid oz. sulphuric acid, 3 fluid oz. water. Add the sulphuric slowly to the water (contained in a porcelain basin or bowl) ; wrap the cyanide in a thin paper bag and drop into the acid and water, by means of a string passing through a trap-door and released from outside. The proportions should always be about the same, but the quantities may be varied according to the nature of the pest.

Carbon-bisulphide.—A highly volatile and inflammable clear liquid, the vapour of which is fatal to insect life. It is used for the destruction of ground insect pests, especially where these occur in colonies, as termites, grain pests, etc. The poison may be applied to termites' nests by saturating bolls of cotton-wool, dropping one of these in each burrow and quickly closing up the latter. The vapour, being heavier than air, sinks to the bottom of the crevices and permeates the whole " nest." For underground pests, holes may be made with a dibbler a few inches deep and distant, dropping a teaspoonful of the liquid into each and closing it up. No naked light must be exposed when dealing with this poison.

Tobacco-smoke is often used for fumigating plants in glass-houses, being a powerful insecticide for certain insects. It is made by burning tobacco, or paper steeped in tobacco juice, *without flame*. For facility, however, " nicotine vaporisers " and similar commercial preparations are recommended.

REPELLENT INSECTICIDES

Camphor has a value as a repellent insecticide. Placed in wardrobes, trunks, etc., it is considered to keep away moths, cockroaches and other insects. It may also be burned and used as a fumigant for mosquitoes, etc.

Naphthalene, obtained from distilled coal and supplied in the forms of flakes and small balls, has the property of repelling weevils and moths. It is more effective than camphor for placing among clothes, stored grain, etc.

Creosote or **Carbolic Acid** when applied to wood and timber prevents for a time the attacks of termites and fungi. Mixed with tar, its effectiveness is increased and more lasting.

Gondal fluid.—An Indian preparation recommended by Dr. Watt for painting on the stems of Tea bushes as a preventive against termites. The following formula is given : 4 oz. gum ; 8 oz. asafoetida ; 8 oz. bazaar aloes, 3 oz. castor cake. Mix with boiling water, and add clay to thicken if required. (See *Vegetable Insecticides.*)

Lime acts as a repellent, as insects dislike to feed on foliage treated with this substance. It may be applied dry as a dusting powder, or as a whitewash on the trunk and branches of trees. See p. 459, etc.

VEGETABLE INSECTICIDES

Certain plants possess properties injurious or even fatal to some insects. Thus tobacco leaves are sometimes chopped and spread around tender plants to afford protection from injurious insects (see also *Tobacco-juice*). The leaves of *Lobelia nicotianaefolia* are similarly used in up-country gardens in Ceylon. *Derris elliptica* (Tuba-root of Malaya), *D. fuliginosa* (Kalawel, *S*) both leguminous climbers, species of *Alocasia* (Habarala, *S*), and *Acorus Calamus* (Calamus-root or Wada-kaha, *S*), are all considered to be effective against certain insects and termites, the roots being pounded and spread around the affected plants.

Quassia, Quassia-chips, or **Bitterwood** consists of the intensely bitter juice of the W. Indian tree, *Picraena excelsa* (Simarubaceae), which is fatal to many forms of sucking insects, particularly aphides. For use, take 1 lb. quassia chips, 1 lb. soft-soap, and 5 gall. water ; boil for 2 hrs., strain the liquid, and add 5 gall. more water. This solution has been recommended in Jamaica for black-ants. It should not be sprayed on plants bearing edible fruit or leaves, as the quassia imparts a bitter taste not easily got rid of.

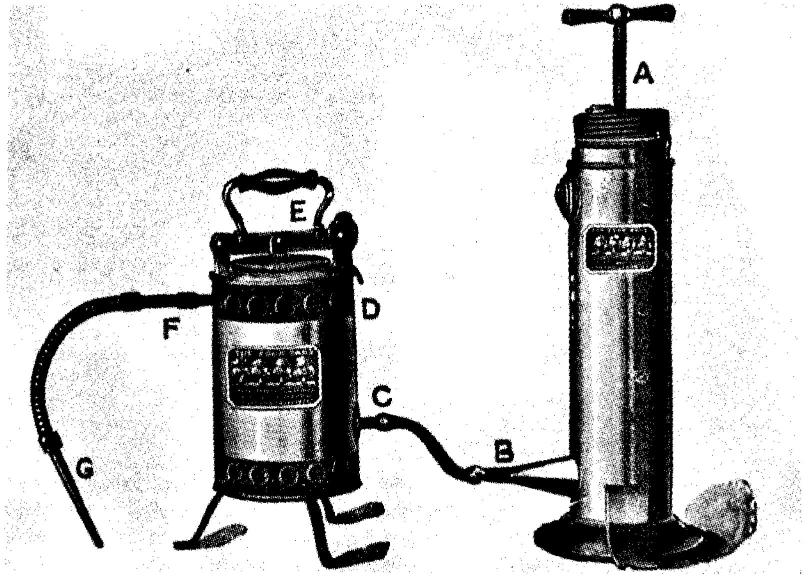
Insect-, Persian-, or **Dalmatian-powder** is prepared from the finely-ground dried flower-heads of *Pyrethrum roseum* and similar species. It is a useful insecticide,

both as a stomach and contact poison, being especially effective against fleas, lice, and bed-bugs. The crushed leaves of *Tephrosia Vogelii* also contain an alkaloid which is fatal to many insects.

Entomogenous fungi.—Many insects, such as beetles, moths, scale-insects, grass-hoppers, mealy-bug, etc. are subject to a growth of parasitic fungi upon their bodies, this being one of nature's methods of control. Successful attempts at propagating and inoculating with such fungi have been made, especially in the case of the locust fungus in S. Africa. The method of infecting the latter is by dipping some of the young insects (hoppers) in a culture of the fungus, and then releasing them to spread the parasite among their fellows.

FOR GROUND PESTS

Ant Exterminator.—A useful device for destroying termites and other ground pests consists of a charcoal burner with pump and nozzle for forcing smoke charged with poison fumes into holes or crevices. The charcoal (in C D) being set alight, a handful of a mixture (as arsenic and sulphur) is thrown over it and the lid firmly clamped into position. A flexible nozzle (G) is pushed into the main entrance of the nest, and all other holes are plugged with clay. The pump (A) is then worked and forces the vapour into the galleries of the nest. If little jets of smoke are seen rising



"Antipest" Fumigator for Ant Nests, etc.

from unsuspected openings, these should be immediately stopped with mud. After a few minutes of pumping, the nozzle may be withdrawn and the hole plugged with clay. The nest should remain undisturbed for a week, when the mound may be dug and levelled. If opened too soon some of the insects will revive. In some few cases there may be feeble signs of renewed activity, in which case a second application should complete the work of destruction. The "exterminator" may also be used for driving snakes or rats out of their nests or for asphyxiating them.

Poison baits for ants and termites may consist of a mixture of arsenic, sugar, flour, and tallow, or of a stiff dough made of Paris Green (1 oz.), flour (4 oz.), and sugar (3 oz.), formed into small lumps and placed in holes where the ants are found. Where it is dangerous to use arsenic, a paste made of 2 oz. borax and 4 oz. sugar may answer the purpose.

Ants attacking seed boxes, flower-pots, etc.—The boxes or pots may be placed

on a stand, with the legs of the latter placed in tins containing kerosene, as is often used for cupboards, etc., in bungalows.

Termites or white-ants, etc.—It is always advisable when sowing seed, planting out or transplanting in a locality subject to these, to fork into the soil a mixture of lime and sulphur, or lime alone. Where a stronger application is necessary, a sprinkling of Vaporite or carbolic disinfectant-powder may be found efficacious. Watering the ground with a weak solution of Cyllin is also an effective ant-destroyer. The smell of tar is obnoxious to most insect life, and water impregnated with tar may sometimes be applied to the ground with good effect. For painting on the base of trees as a preventive against termites, dilute tar or kerosene is sometimes used with good results.

Black-ants are often troublesome in gardens, undermining paths, lawns, etc. According to the *Jamaica Bulletin*, nothing has been so successful in expelling them as a solution of Bitterwood. (See *Quassia.*)

Ants in Lawns.—An application of sulphate of ammonia, say 1 oz. to 2 gall. of water, poured into their burrows, has been found to have good results in driving these away.

Vaporite.—A powdered preparation which is very efficacious against most ground pests, such as eelworms, wireworms, cockchafers, and various grubs. It may be applied simply by mixing with the surface soil, or by inserting a teaspoonful each into holes made with a stick or crowbar in the ground about 1 ft. apart.

Quick lime.—Fresh-slaked lime has insecticidal value when dusted over the ground or mixed with the soil. It also serves as a useful diluent of poisonous powders, being often used in the preparation of some of the more active insecticides, also in fungicides to neutralise their caustic action on foliage.

COMMON INSECT PESTS OF CEYLON

Arranged According to Crops or Plants Attacked.

Parts usually attacked are indicated thus: (L.) = leaves; (St.) = Stem; (Br.) = branches; (F.) = fruit; (P.) = pods; (Fol.) = foliage; (R.) = roots; (Rh.) = rhizomes; (Sh.) = shoots.

Only brief and provisional remedies can be given here; these are omitted where more complicated or expert treatment is required.

General Crop Pests.

Crop.	*Name of Pest, Parts Usually Attacked, and Simple Treatment.*
Annato . . .	**Mosquito Blight or Bug.** *Helopeltis antonii.* (Young sh.) Catch by hand-net; emulsion spray.
Cacao . . .	**Borer.** *Arbela quadrinotata.* (St.) Plug holes in bark with tar.
,, . . .	**Helopeltis Bug or Mosquito Blight.** *Helopeltis antonii.* (F. and young fol.). Collect by hand-net. Emulsion spray.
,, . . .	**Pod Borer.** *Dichocrocis punctiferalis.* (F.) Collect and destroy affected pods.
Camphor . .	**Caterpillar.** *Papilio clytia.* (L.) Spray with lead arsenate.
,, . .	**Shot-hole borers.** *Xyleborus spp.* (St. and br.) Cut and destroy affected parts.
Cardamom . .	**Bug.** *Ischnodemus noctulus.* (Fol.) Emulsion spray.
,, . .	**Pod-borer.** *Lampides elpis.* (Fr.) Emulsion spray.
,, . .	**Root-borer.** *Hilarographa caminodes.* (Rh.)
,, . .	**Stem-borer.** *Dichocrocis punctiferalis.* (St.) Cut and destroy affected stems.
Castor-oil Plant .	**Bug.** *Aleyrodes ricini.* (Fol.) Emulsion spray, etc.
,, ,, .	**Caterpillar.** *Arctia ricini.* (Fol.) Lead-arsenate spray.
Cinnamon . .	**Gall-mite.** *Eriophyes boisi.* (Fol.) Sulphur spray.
Citronella Grass .	**Scale Bug.** *Chionaspis graminis.* (Fol.) Emulsion spray.
Coconut Palm .	**Red Weevil.** *Rhyncophorus ferrugineus.* (St. and crown.) Collect and destroy. (See *Palm beetles.*)
,, .	**Black- or Rhinoceros-Beetle.** *Oryctes rhinoceros.* Tender part of crown. Harpoon in their burrows and destroy.
,, .	**Coconut Caterpillar.** *Nephantis serinopa.* (Fol.) Cut and burn infested fronds.

Crop.	Name of Pest, Parts Usually Attacked, and Simple Treatment.
COFFEE, "ARABIAN" "ROBUSTA," AND OTHER VARS.	Green Bug. *Lecanium viride.* (Fol.) Emulsion spray.
,,	Brown Coffee-bug. *Lecanium (Saissetia) hemisphaericum.* (Fol.) Emulsion spray.
,,	Coffee-borer. *Zeuzera coffeae.* (St. and br.) Cut and destroy infested parts.
,,	Coffee-beetle. *Stephanoderes hampei.* (Berries.) Kenya, etc.
,,	Cockchafer-grubs, various species. (R.) Vaporite.
,,	Black Bug. *Lecanium nigrum.* (Br.) Emulsion spray.
COTTON	Cotton Bugs or Stainers. *Dysdercus cingulatus, Serinetha augur, Oxycaraenus lugubris.* (Lint.) Spread lint in sun.
,,	Pink Boll-worm. *Platyedra gossypiella.* (P.) Destroy infested bolls.
,,	Mealy Bug. *Pseudococcus virgatus.* (Fol. and young br.) Emulsion spray.
,,	Defoliator. *Amyna selenampha.* (Fol.) Lead-arsenate spray.
CROTON-OIL PLANT	Pod-borer. *Dorylus orientalis.* (Fr.) Vaporite.
GROUND-NUT	Leaf-miner. *Stomopteryx nerteria.* (Fol.) Emulsion spray.
,,	Leaf-roller. *Caprinia conchylalis.* (Fol.) Lead-arsenate spray, etc.
LAGOS-RUBBER (*Funtumia*).	Caterpillar. *Attacus atlas.* (Fol.) Lead-arsenate spray.
MAHOGANY	Shoot-borer. *Hypsipyla robusta.* (St. or br.) Cut off and burn affected parts.
,,	Scale Bug. *Aspidiotus aurantii.* (Br.) Emulsion spray.
MULBERRY	Flat Bug. *Lecanium expansum.* (Fol.) Emulsion spray.
NUTMEG	Cockchafer-grub. *Lepidiota pinguis.* (R.) Vaporite.
PARA RUBBER	Stem and Root-Borer. *Batocera rubus.* (St. and R.)
,,	Black Bug (*q.v.*). *Lecanium nigrum.* (Fol. and young branches.)
,,	Scale Bug. *Lecanium marsupiale.* (Fol.) Emulsion spray.
PEPPER	Scale Bug. *L. peradeniyense.* (Fol.) Emulsion spray.
,,	Leaf-roller. *Sylepta sabinusalis.* (Fol.) Lead arsenate.
RHEA OR RAMIE	Arrakkodian, *T*; "Godavellu," *S*; Swarming Caterpillar. *Spodoptera mauritia.* (Fol.) See fig. on p. 456.
RICE (PADDY)	Paddy Bug. *Leptocorisa varicornis.* (Fl. heads.) Catch by hand-nets, or trap by screens smeared with gum.
,,	Paddy Weevil. *Calandra oryzae.* (Grain.) Place naphthalene balls in bags with grain.
,,	Shot-hole Borer. *Xyleborus fornicatus.* (Mature st. and br.) Cut out and destroy affected branches; burn prunings on field. Plants are not affected till about 9 months after pruning.
TEA	White-ant or Termite. *Calotermes militaris.* (Live or dead st.) See *Vaporite*, etc.
,,	Helopeltis or Mosquito Blight. *Helopeltis antonii.* (Fol.)
,,	Fringed Nettle-grub. *Natada nararia*, etc. (Fol.) Hand-pick; lead-chromate spray.
,,	Bag-, Faggot-, or Case-Worms. *Psychidae.* (Fol.) Hand-pick.
,,	Tea-tortrix. *Homona coffearia.* (Fol.) Collect and destroy egg masses. Lead-chromate spray.
,,	Lobster Caterpillar. *Stauropus alternus.* (Fol.) Hand-pick.
,,	Thrips. *Heliothrips rubrocinctus.* (Fol.) Sulphur spray.
TEAK	Leaf-eater. *Hybloea puera.* (Fol.) Lead-arsenate spray.
TOBACCO	Stem-borer. *Gnorimoschema heliopa.* (St. base.) Cut out grub; destroy badly-attacked plants.

FRUIT PESTS

Crop.	Name of Pest, Parts Usually Attacked, and Simple Treatment.
CHERIMOYA, CUSTARD-APPLE, JAMBU, ROSE-APPLE, ETC.	Black Scale Bug. *Lecanium nigrum.* (Br.) Emulsion spray.
	Gall-fly. *Psylla sp.* (Fol.)
MANGO	Fruit Fly. *Chaetodacus ferrugineus.* (Fr.) Collect and destroy infested fruits.

Crop.	Name of Pest, Parts Usually Attacked, and Simple Treatment.
MANGO	Mango Weevil. *Cryptorhynchus mangiferae.* (Fr.) Collect and destroy infested fruits.
,,	Scale Bug. *Lecanium mangiferae.* (Fol.) Emulsion spray.
ORANGE, LIMES, LEMONS, ETC.	Scale or Sooty-mould Bug. *Coccus viridis*; *Lepidosaphes spp.* and *Aleurocanthus spp.* (Fol.) Emulsion spray.

VEGETABLE PESTS

Crop.	Name of Pest, Parts Usually Attacked, and Simple Treatment.
BANDAKKA (*Hibiscus*)	Leaf-roller. *Sylepta derogata.* (Fol.) Lead-arsenate spray.
BEANS (*Phaseolus*)	Fly Maggot. *Agromyza phaseoli.* (St. and fol.) Destroy affected plants; apply vaporite as preventive.
,,	Sucking Bugs. *Coptosoma cribaria* and *Riptortus fuscus.* (Fol.) Hand-pick.
,,	Blister Beetle. *Mylabris pustulata.* (Black beetle with red bands.) Hand-pick with a leaf or rag, or by hand-net.
BRINJAL (*Solanum*)	Stem-borer. *Leucinodes orbonalis.* (Young sh.) Cut and destroy infested shoots.
,,	Sucking Bug. *Urentius echinus.* (Fol.) Emulsion spray.
CABBAGES (*Brassica* family).	Caterpillar. *Plutella maculipennis.* (Fol.) Hand-pick.
,, ,,	Caterpillar. *Crocidolomia binotalis.* (Fol.) Hand-pick.
,, ,,	Black Grub or Cut-worm. Grub of noctuid moth. *Agrotis spp.* (Young seedlings.) Collect and destroy. See *Insect traps.*
GOURDS, PUMPKINS, ETC.	Sucking Bug. *Leptoglossus membranaceus.* (Fol. and young st.) Collect and destroy. Arsenate spray.
,, ,,	Leaf Beetle. Several species of *Chrysomelidae.* (Fol.) Arsenic spray.
,, ,,	Fruit Fly. *Dacus ferrugineus.* (Fr.) Hand-pick; destroy infested fruits.
MAIZE	Borer. *Chilo simplex.* (St.) Destroy affected plants; employ light-traps for catching moths. See p. 455.
POTATO	Bulb-borer. *Dorylus orientalis.* (Tuber.) Vaporite.
TOMATOES	Gall Worm. *Heterodera radicicola.* (R.) Vaporite (*q.v.*).

PESTS OF ORNAMENTAL PLANTS

Crop.	Name of Pest, Parts Usually Attacked, and Simple Treatment.
AMARYLLIS	Caterpillar. *Polytela gloriosae.* (Fol.) Lead-arsenate spray.
BAMBOOS	Scale Bug. *Asterolecanium bambusae.* (St.) Emulsion spray.
,,	Aphis. *Oregma bambusae.* (St.) Tobacco-juice spray.
CYCAS	Caterpillar. *Cyaniris puspa.* (Fol.) Lead-arsenate spray.
,,	Caterpillar. *Catachrysops pandava.* (Young fol.) Lead-arsenate or kerosene spray.
DAHLIA	Bulb-borer. *Dorylus orientalis.* (Tuber.) Vaporite (*q.v.*).
FERNS	Flea-beetle. *Hypnophylla flavipennis.* (Fol.) Lead arsenate.
,,	Scale. *Lecanium hemisphaerica.* (Fol.) Emulsion spray.
HIBISCUS	Leaf-roller. *Sylepta derogata.* (Fol.) Lead arsenate; destroy infested flower buds.
,,	Flower-beetle. *Mylabris pustulata.* (Fl. buds.) Lead arsenate, etc.
IPOMOEA, DIFFERENT SPP.	Hairy Caterpillar. *Euchromia polymena.* (Fol.) Lead-arsenate spray; collect and destroy caterpillars.
JASMINUM PUBESCENS	Bud-borer. *Hendecasis duplifascialis.* (Fl. buds.) Lead-arsenate or kerosene spray.
LACE-BARK TREE	Caterpillar. *Heortia vitessoides.* (Fol.) Arsenate spray.
PALMS IN POTS	Fringed Bug. *Cerataphis lantaniae.* (Fol.) Emulsion spray.
,, ,,	Caterpillar. *Elymnias fraterna.* (Fol.) Hand-pick, or lead-arsenate spray.
,, ,,	Scale Bug. *Lecanium hemisphaericum.* (Fol.) Syringe with emulsion. The brown dead scales adhere to the surface and shelter numerous eggs underneath.

Crop.	Name of Pest, Parts Usually Attacked, and Simple Treatment.
PERGULARIA . .	Scale Bug. *Lecanium caudatum.* (Fol.) Emulsion spray.
PORTLANDIA (SHRUB)	Caterpillar. *Caprinia conchylalis.* (Fol.) Paris-Green, or lead-arsenate spray.
ROSES . . .	Scale Bugs. *Chrysomphalus aurantii* and *Icerya aegyptiaea.* (St. and fol.) Emulsion spray.
" . . .	Rose Beetle. Several spp. (Fl. and young fol.) Collect and destroy, or spray with lead arsenate.
SALVIA, THUNBERGIA, ETC.	Lantana Bug. *Orthezia insignis.* (Fol. & st.) Emulsion spray.

LAND LEECHES

The common land-leech (*Haemadipsa zeylanica*) occurs in Ceylon up to about 5,000 ft. elevation or where rain is plentiful, being a particularly troublesome pest to human beings and animals during wet weather. It does not occur near the sea, and its distribution has recently extended to Nuwara Eliya, over 6,000 ft. elevation. In India, leeches occur up to about 4,000 ft. in the wet region. The Ceylon leech is brown in colour, about 1 in. in length and ⅛ in. in breadth. Reproduction is by means of eggs laid in cocoons in the ground, several young leeches developing within each cocoon.

The leeches rest, by means of a posterior sucker, upon the tops of grass and other leaves or stems and await the passing of a warm-blooded animal, the approach of which is detected with extraordinary rapidity by all leeches in the immediate vicinity, and they quickly travel to it without delay. They are extremely persistent, working their way to the skin of human beings through clothing and even through the lace-holes of boots, and also cause considerable annoyance to animals. Their bite is usually painless and may remain undetected until indicated by a stream of blood which flows from the wound. When gorged with blood, they drop from their host. If discovered feeding, they should not be forcibly pulled off, as portions of the mouth-parts are thus liable to be left in the wound, giving rise to considerable inflammation and, possibly, suppuration. If touched with a little salt or vinegar, or a lighted match or cigarette, they will rapidly release their hold, and it is advisable to treat their bites as early as possible with tincture of iodine, milton, or ordinary salt.

Leeches do not occur in dry weather, except in moist localities, as by the side of streams or pools, but they rapidly appear on the arrival of rainy weather. In the dry region, however, they are seldom if ever seen, even during the brief rainy period. Where they occur naturally it is difficult to adopt preventive measures, though much may be done to control the pest by keeping the grass closely cut, attending to the removal of leaves or rubbish, reducing the shade of trees, and by draining swampy or wet land where possible.

Leeches may easily be destroyed by spraying with contact poisons, as tobacco juice, copper sulphate, kerosene oil, various disinfectants and insecticides (*q.v.*), but it is scarcely practicable to apply these in sufficient strength and quantity without killing the grass. Lime and salt are a deterrent to them, and smearing one's legs with lime-juice, citronella or other pungent aromatic oil affords protection from their bite. A cured tobacco leaf wrapped round each leg, inside the stocking or puttee, is a preventive well known to sportsmen. The oil of *Kokoona zeylanica* ("Kokun" or "Pottu-eta tel," *S*) is much used by pilgrims to Adam's Peak as a protection against leeches.

CHAPTER XXXV

FUNGUS AND OTHER DISEASES

MANY extensive and insidious diseases of garden and plantation crops are due to the attacks of a class of lowly organised plants known as fungi.

Structure of Fungi.—The vegetative portion of a fungus, termed *mycelium*, consists of long, thin filaments or threads called *hyphae.* When the hyphae are abundant, the mycelium resembles a loose, tangled mass of soft, white threads. Such mycelia may commonly be observed among dead leaves, on decaying wood, etc. In cases where the hyphae have penetrated the tissues of a plant, microscopic examination is necessary to demonstrate their presence.

Reproduction is by means of spores, which vary considerably in size, shape and mode of origin. Each spore is capable of giving rise to a new plant like its parent. They may be borne directly on the mycelium, but in many species, *e.g.* mushroom, they are produced on a conspicuous structure termed a *sporophore* or *fructification.*

Mode of Life.—Fungi are all characterised by a complete absence of green colouring-matter (*chlorophyll*). They are therefore unable to manufacture the complex carbon compounds necessary for their nutrition, and so are compelled to obtain these compounds ready-made from the bodies of living or dead animals or plants. The fungi which obtain their nutriment from the tissues of living animals or plants are termed *parasites*; those which feed upon dead organic material, *saprophytes.* All parasites cause disease and consequently loss. The loss may be insignificant or of national importance, according to the virulence of the attack.

How Fungus Diseases are Spread.—Fungi produce spores in immense numbers; these are light and easily carried by various agents, such as wind, water, insects, birds and other animals. In many ways man is an active disseminator of fungus diseases. He is known to have carried disease from one district to another on his clothes and on agricultural implements, and from one country to another on shipments of seed and nursery stock. Therefore, growers should take precautions against introducing diseases with new stock from other countries or districts. Recognising the possibility of introduction of virulent diseases from other countries, Governments have adopted legislative measures to prevent, as far as possible, the further introduction of diseases with imported seeds or plants.

Conditions Favourable for Infection.—Fungi grow best in damp, warm weather, and in shady places. Direct sunlight inhibits fungus growth. Conditions which restrict the entry of sunlight and prevent free circulation of air and evaporation of moisture—as by crowding plants together, or by growing them under dense shade—are consequently favourable to fungus diseases. The "Damping off" disease (*Pythium*) of seedlings usually occurs under these adverse conditions.

Epidemics.—A disease which has previously done little damage may, when favourable conditions occur, become virulent and spread rapidly, becoming epidemic and causing great loss. Several such epidemics are well known in history. The failure

of the potato crop in the British Isles in 1845 was due to the ravages of the Potato-blight (*Phytophthora infestans*); while the attack of Coffee leaf-disease (*Hemileia vastatrix*) had a disastrous effect on the coffee industry in Ceylon in the years 1875–1885. An epidemic can only occur where large numbers of the same kind of plant are growing in close proximity, as in the cultivation of single crops.

PREVENTIVE MEASURES

Prevention Better than Cure.—It is usually easier to prevent than to cure diseases. A disease which is of little economic importance to-day may, under favourable conditions, rapidly become very destructive. By avoiding conditions known to encourage disease, much can be done to prevent it. On the first appearance of a disease, immediate steps should be taken to prevent its further spread.

Good Cultivation.—Many fungi attack only plants in a weakly condition. Vigorous growing plants can often withstand attack, while plants of feebler vitality succumb to it. It follows, then, that good cultivation, as secured by proper draining, manuring, careful pruning, etc., is an effective means towards the suppression of fungus diseases, in so much that it tends towards the production of vigorous plants.

Destruction of Diseased Plants.—A diseased plant is a source of infection for neighbouring plants, as large numbers of spores, which are carried by the air, are produced on the diseased individual. The early destruction of diseased plants is, therefore, a primary means of checking plant disease. Fire is the only satisfactory method of destruction. The burning of diseased material may often be facilitated by the use of kerosene or petrol. Where such material is too wet to burn, even with the aid of these, it should be buried deeply with lime; it should never be left lying about to dry, or thrown on the rubbish heap to decay. If roots are attacked they should be dug up and burned, otherwise there is a risk of the fungus spreading through the soil to neighbouring roots.

Sanitation.—Many disease organisms persist from year to year on weeds, neglected trees, and debris of the fields. Old stumps and logs make excellent nurseries for fungi which attack rubber, cacao, coffee and many other plants. The clearing up of places which harbour disease is, therefore, essential for good sanitation. Where a temporary crop has been badly attacked, the debris, after harvesting the crop, should be collected and burned, thus destroying great quantities of spores and mycelium and diminishing the risk of recurrence the following year.

Rotation of Crops.—Many disease organisms are capable of attacking only one species or one family of plants. Thus neither the "potato-blight" nor "club-root" ever attacks peas or cereals. Where rotation of crops is practised, an interval of several years separates two successive crops of one kind on the same ground. This interval causes the disease organisms in the soil to perish for want of suitable food material. For this reason, rotation of crops has been found to be an effective preventive of certain diseases and should be practised whenever possible. In arranging a rotation, care must be taken not to plant in succession closely related species; *e.g.* tomatoes should not follow potatoes, chillies, or brinjals; nor should cabbages follow turnips, cauliflower, and other members of the same family. (See *Crop Rotation*, p. 32.)

Wounds.—Many fungi can obtain entrance into the host plant only through a wound. Needless or promiscuous wounding of plants, particularly trees, should therefore be avoided. Where a wound has been caused accidentally or by pruning, it should be painted with white-lead, tar, or other antiseptic preparation to prevent the entry of disease organisms.

Clean Seed.—As fungus spores are very minute, and so escape observation, disease organisms are often sown with seed, *e.g.* the "smut disease" of wheat. To obviate this, only clean seed, selected if possible from healthy plants, should be sown. In some cases it is advisable to disinfect the seed before sowing. (See *Disinfection of Seeds.*)

Isolation of Infected Areas. (See *Root disease.*)

Disease-resistant Varieties.—Some varieties or species of plants are more or less immune from disease, while others, cultivated under the same conditions, are specially susceptible to it. Therefore varieties which are the least susceptible, consistent with other desirable qualities, should be selected for cultivation. The raising or selection of disease-resisting varieties is now recognised as a matter of considerable importance in horticulture and agriculture.

Influence of Manures.—The spores of certain disease-causing fungi will pass through the digestive tract of an animal and yet retain their vitality. Disease may thus be disseminated in the manure. If diseased tubers, fruits, or other material are fed to pigs or other stock, care should be taken that the manure is used only for crops which will not be affected by the disease. It is preferable, however, to destroy the fungus spores by boiling the diseased material before feeding to stock.

Artificial Manures are known to increase or diminish the power of disease resistance of certain plants. Generally speaking, an excess of nitrogenous manure predisposes plants to disease, particularly leaf-disease; potash and phosphates increase resistance to disease, but cases of the opposite effect have also been observed with phosphates. See *Fertilisers.*

Spraying.—The main purpose of spraying is preventive rather than curative (see p. 472). If the organism is confined to the surface of the plant, it may be possible to effect a cure by the use of a spray; but where it is more deeply situated and beyond the reach of the fungicide, a cure is impossible. The spray will, however, kill the spores of the disease as they are produced, and so neighbouring plants are protected against infection. By spraying healthy plants, the germination of spores which may happen to lodge on them is prevented. As soon as an attack is noticed, spraying should be resorted to. Some of the principal sprays or fungicides in use are given below.

Co-operation.—In the fight against fungus diseases, co-operation is absolutely necessary. It is impossible to stamp out disease in a garden when every breeze carries spores from neighbouring gardens or plantations, whose owners take no active preventive measures. Plant Pest Laws have now been instituted in most countries to compel negligent land-owners to take active measures towards eradicating certain scheduled diseases.

FUNGICIDES

Bordeaux Mixture is perhaps the most important and most commonly employed fungicide. It consists of copper-sulphate, lime, and water, in various proportions, according to the strength required. The following formula makes a good standard mixture: Copper-sulphate, 5 lb.; lime, 5 lb.; water, 50 gall. Dissolve the copper-sulphate in 25 gall. of water in a wooden tub, place the lime in another vessel and add a few pints of water, or sufficient to slake the lime and form a thick creamy paste. Then add water to make 25 gall. If the sulphate is dissolved in hot water it must be allowed to cool before mixing. The lime must be of the best quality, in lumps, and as freshly burnt as possible. Powdered air-slaked lime is unsuitable. When ready to commence spraying, pour together equal quantities of the copper-sulphate solution and lime-water (after stirring) through a strainer tied across the top of a clean wooden vessel. The two streams should blend as they fall to ensure a good mixture with fine grain, which will hang in suspension long enough to permit of spraying.

Where large quantities of the mixture are required it is convenient to make up concentrated solutions of the two ingredients (which, apart, will keep indefinitely), and mix them together when required. If for this purpose, 50 lb. of copper-sulphate be dissolved in 50 gall. of water, each gallon then contains 1 lb. sulphate. Lime solution should be made of similar strength. Always dilute the concentrated solu-

tions to the required strength before mixing, otherwise a coarse precipitate which settles quickly is formed. Bordeaux mixture will not keep, and only a freshly made mixture should be used.

Before using, the mixture should be tested to determine whether there is an excess of copper-sulphate or lime. An excess of the former has an injurious burning effect on the leaves, whilst a large excess of lime reduces the efficacy of the mixture. A test is easily carried out by the use of litmus paper, as in testing *Soil Acidity* (*q.v.*). An acid reaction denotes excess of copper-sulphate, while excess of lime will give an alkaline reaction. Another simple test is to immerse a bright knife-blade or wire-nail in the liquid for a few minutes; if a deposit of copper forms on the blade or nail, the mixture is unsafe and more lime should be added.

Adhesive Mixture.—Bordeaux-mixture adheres well to sprayed plants, but when heavy rains are expected it is advisable to increase its adhesive properties by the addition of the following: Dissolve 1 lb. washing soda in 1 gall. of boiling water, then add 2 lb. of resin and boil for about an hour, stirring continually. This when cool should be added to 30 gall. of Bordeaux mixture.

Burgundy Mixture.—Where good, freshly burnt, stone lime is difficult to obtain, "Burgundy mixture" may be used instead of the "Bordeaux." In the preparation of this mixture, a solution of washing soda is used instead of lime-water, otherwise the method of preparation is the same. A good formula is: 5 lb. copper sulphate, 6¼ lb. washing soda, and 50 gall. of water. An excess of soda will scorch the leaves, so that the solution before use should be tested with red litmus paper, as already stated. If this turns blue, more copper-sulphate solution should be added. "Burgundy-mixture" is more expensive than "Bordeaux," but it is more easily prepared; it adheres better, and is not so liable to clog the sprayer. Commercial forms of it, which require merely the addition of water, are obtainable.

Flowers of Sulphur, or Sulphur and Lime, are both effectual fungicides against leaf-diseases or mildews, being dusted on the foliage while the latter is damp with dew, as in the morning. It is used for controlling the Leaf-disease *Oidium* on Hevea plantations, being applied through a spraying machine. The dusting may be done in belts of 50–60 yds., at intervals of about 8 days, or 6 applications in all, while the foliage is young. One machine may do 100 acres in a day, and the cost should not exceed about Rs. 5 per acre, exclusive of machine. Lime-sulphur solution also makes a useful insecticide, being prepared by mixing 4 lb. quick-lime with 4½ lb. in 10 gall. water to form a paste. When slaking and mixing is complete, add 10 gall. water and boil for an hour. When cool, dilute with 10 times the quantity of water. The solution should not be used in copper spraying machines.

Potassium Sulphide Spray, prepared by dissolving 1 oz. of potassium sulphide in 3 or 4 gall. of water, is effective against powdery mildews. It is sometimes used where it is undesirable to have the foliage discoloured by other sprays.

Lime.—Heavy applications of quick-lime are very effectual against fungi which live in the soil and cause root disease, *e.g.* "club-root" or "slime fungus" disease (*Plasmodiophora Brassicae*), which is so destructive to cabbage and other members of that family. It is the most effective agent known against root diseases, and should be well forked into the soil in large doses where these occur. (See *Root Diseases.*) **Dilute lime-wash** is sometimes applied by a syringe or brush to trees or bushes when deciduous, or after pruning, as on Tea fields. This acts as a check on the growth of moss as well as on certain insects and fungi. For general herbaceous crops, 1½–2 tons of quick-lime per acre is a suitable dressing. (See *Lime,* also *Cabbage,* etc.)

Tar.—Gas-tar or Stockholm-tar is used for disinfecting or protecting wounds of trees or woody plants. It should be applied to the exposed wood only, care being taken that it does not run over the healthy bark, which it is liable to damage. Tar forms a waterproof antiseptic covering on the wood, preventing the entry of wood-rotting fungi and of insects, and allows the wound to heal over cleanly. Gas-tar is a product obtained in the process of coal-gas manufacture; it is more liquid than Stockholm-tar obtained from pine-pitch.

Brunolinum, Izal, Agrasol.—These are thin liquid preparations used to protect bark wounds. On rubber estates where bark-rot is often prevalent, one or other of these disinfectants is applied regularly after every tapping during wet weather. The strength of the preparation varies with the kind used. A 5% solution is recommended as a preventive of bark-rot, and 20% for a cure.

Corrosive Sublimate (Bichloride of mercury), a powerful disinfectant, is recommended for disinfecting pruning instruments when working in blight-infested orchards, and sometimes as a steep for seed potatoes against "potato-scab," the potatoes being immersed before sowing in a solution of 2 oz. sublimate to 15 gall. of water for 1½ hrs. It is also sometimes employed for disinfecting grain, but owing to its poisonous nature is being supplanted by formalin for this purpose. It should never be sprayed on plants. For poisoning books and specimens against mould and insects, it is often used in the following form: corrosive sublimate ½ oz., carbolic acid ½ oz., methylated spirit 1 pint; apply the solution with a soft brush.

Disinfection of Seeds.—As a preventive of certain diseases, such as the "smuts" of cereals, the seed should be disinfected before sowing with one or other of the following solutions, viz.:

Formalin: Soak the seed for 2 hrs. in a solution made with 1 pint of formalin to 50 gall. of water, and then spread out to dry. *Copper-sulphate*: Soak the grain for 12–16 hrs. in a solution of copper-sulphate (½ lb.–10 gall. water), then remove the grain and spread out to dry for 24 hrs. Lest this diminishes the germination capacity of the seed, immerse the latter immediately after for 5 mins. in *milk of lime* (made by adding 7 lb. of good quick-lime to 10 gall. water). *Corrosive sublimate*: Soak the seed for 15 minutes in a solution consisting of 1 part sublimate to 1,000 parts water.

Sterilizing Seed-beds.—Losses are sometimes experienced through disease occurring in seed-beds. The remedy is to sterilise the soil before sowing the seed, as by burning. This may be effected by burning brushwood laid on the surface, the resulting heat being sufficient to penetrate the soil for several inches and destroying not only fungus organism, but also weed-seeds. Sprinkling with dilute formalin (2% in water) at the rate of 2 gall. per sq. yd. is also effective.

Diagnosis of Plant Diseases.—It is important that plant diseases should be treated immediately they are noticed, and effective treatment will depend upon accurate diagnosis. The part which appears diseased to the eye is not necessarily the seat of the trouble; thus the discoloration and premature falling of leaves may be primarily due to root trouble, caused possibly by unfavourable soil conditions. If the position of attack can be located, remedial treatment may often be devised by the practical man, though whenever possible expert advice should be obtained.

Root Disease.—When roots of herbaceous plants are attacked by disease, the whole plant usually dries up and the leaves droop as though suffering from lack of water. This type of disease is commonly known as *Wilt, e.g.* tobacco-wilt, tomato-wilt, etc. Trees usually exhibit signs of root disease by the leaves drying up and falling. It is, as a rule, impossible to cure root disease, and treatment must be mainly directed towards preventing its spread. The roots of dead and dying plants should be removed and burned, the soil opened up and treated with quick-lime, which should be lightly forked in. For affected trees, like Hevea, as much as 50 lb. of lime per tree may be used, and for shrubs, *e.g.* Tea, about 6 lb. per bush. (See *Lime.*)

Isolation of infected areas.—Where a fungus is capable of growing independently through the soil (e.g. *Fomes* on Hevea), a trench 2 ft. deep should be dug around the affected area, the earth from the trench being thrown within the circle. Similar plants should not be grown on that ground for several years, otherwise the disease is likely to recur.

Leaf Diseases, including mildews, rusts, and leaf-spots. The indications of leaf-disease are the presence of various coloured spots or irregular patches on the leaves. Although these may not kill the plant, they greatly weaken it and reduce the crop. The treatment is spraying, which should also be applied to healthy plants as a preventive. Fallen leaves should be collected and burned. *Powdery mildews* are easily recognised by the presence of white powdery dust. They should be dusted with flowers-of-sulphur, or sprayed with lime-sulphur or potassium sulphide (*q.v.*). *Downy mildews* or *Blights*: The leaves are covered by white fluffy masses of mycelium; spray with Bordeaux-mixture. *Rusts*: So named from the presence of rust-coloured areas on the leaves. They cause considerable loss and are difficult to treat. The use of resistant varieties and maintaining the plants in a vigorous condition are the most effective methods of prevention. *Leaf-spots* and blotches vary in shape, size, and colour, and their treatment generally is spraying with Bordeaux mixture.

Stem or Branch Diseases.—The diseases affecting the stems of herbaceous plants are similar to the leaf-diseases described above. The effects of disease on woody plants are usually distinct, and vary according to the nature of the organism. The chief types are *dieback*, *canker*, *galls*,

and *witches' broom*. The affected tissues must be excised and the wounds painted with tar. In *dieback*, as the name indicates, the stem dies back as the disease progresses. Affected branches must be cut out below the point the disease has reached, and burned. *Cankers* are malformations in the bark, generally resulting in a wound which exposes the wood. *Galls* (see p. 457) are enlargements or outgrowths of the tissues of stems, roots, etc. They sometimes occur on leaves or fruits and are caused by many agents, such as insects, bacteria, slime moulds as well as fungi. See *Witches' Broom*, p. 345.

Fruit Diseases commonly occur as spots, scabs, or rots. The recognised method of preventing them is to spray with Bordeaux or Lime-sulphur solution (*q.v.*). Much may be done to prevent their spread by collecting and burning affected fruit. Care must be taken, however, that none but diseased fruit are handled, as spores may be conveyed to healthy fruit by the hand.

Smut is a common disease of cereals. The grain is entirely destroyed and in its place is a black sooty powder (spores), which gives the disease its name. Sterilization or " pickling " the seed before sowing has been found to be an effective preventive. (See *Disinfection of Seeds*.)

Dry-rot, often due to *Merulius lacrymans* and other fungi, frequently attacks timber in bungalows or other buildings. Soaking the wood in creosote or other efficient wood-preservative is the best preventive.

Damping-off Disease is due to a fungus (*Pythium*) which affects young and small, tender plants, especially seedlings from thickly sown seed. It usually attacks the plants just above the ground-level and, the tissues becoming destroyed, the plants fall over at that point. Excessive dampness, insufficient light or ventilation, overcrowding, and imperfect drainage are conditions to avoid, as they are conducive to the disease.

Sooty Mould.—Orange trees and other members of the Citrus family are peculiarly liable to this fungus disease, which forms a thin black crust on the foliage, sometimes covering the entire leaf, and often blackening the fruits also. It is, however, a superficial growth and does not penetrate the tissues of the plant. Its presence is due to scale-insects (often *Lecanium viride*, or Green-bug) which must be got rid of in order effectually to dispose of the mould. Spraying with petroleum emulsion or a resin wash, followed by syringing with clean water, is the best remedy.

PHYSIOLOGICAL DISEASES

Many diseased conditions are not associated with any particular organism, but are due to a derangement of the life processes of the plant, owing to unfavourable physical conditions, such as excess or insufficiency of water, unsuitable soil or subsoil, absence of a necessary element in food supply, insufficient light, etc., or to causes which are at present little understood. Common examples are the " mosaic disease " of tobacco, cotton and other plants, and " brown bast " of *Hevea*.

Mosaic disease is characterised by mottling of the leaves with different shades of green, the boundaries between the lighter and darker green patches being sharp and distinct. The mosaic disease of tobacco occurs practically wherever tobacco is grown, but no parasite has been detected associated with it. It is probably due to some innate alteration in the function of the plant, due to the presence of an enzyme, and is highly contagious, a minute quantity of sap from a diseased leaf being sufficient to inoculate a healthy specimen. Seed from healthy plants only should be used for sowing. When affected plants have to be handled, care must be taken that healthy plants are not touched immediately after, as the disease may thus be conveyed to the latter.

Brown Bast is a little understood disease of *Hevea*. The latex-producing bark tissue dries up and becomes affected with a brown discoloration. It is believed that this disease is caused by the repeated wounding of the bark in the process of tapping; or it may be due to the continual removal of latex from the bark. The treatment commonly practised is to scrape or strip off the bark from the affected area, and to rest the tree.

Chlorosis or **Pallor** is due to various causes and is generally associated with poor or gravelly soils. It is characterised by the absence or deficiency of the normal green colouring-matter (*chlorophyll*) in the leaves, so that these appear yellowish or white. It may be caused by a deficiency of iron in the food of the plant, iron being a necessary ingredient for the formation of chlorophyll. Where this is the cause, it may be cured by the application of sulphate of iron to the soil. Yellowing of the leaves may also be caused by injurious quantities of soluble salts, poisons, or acid gases, and frequently accompanies wilting and attacks of wire-worms, or other root-feeding insects. When the pallor is due to absence of light, it is known as *etiolation*. By earthing up celery stalks and other edible plants, etiolation is induced and the covered parts become white or blanched, and thereby fit for table use.

Dwarfing.—The reduction in size of the entire plant or of some particular organ is known as " dwarfing " or " nanism." In some cases it is associated with particular disease organisms, but in others it is due to physiological causes. It is frequently a sign of malnutrition due to impoverished soil. The repeated maiming of plants by browsing cattle will cause a similar condition. The miniature trees of the Japanese are produced artificially by continually nipping off the buds as they are formed, and these, it is claimed, live for centuries. Valued as a curiosity, they often fetch high prices. With alpine plants, dwarfing is due to climatic conditions.

Gumming or Gummosis.—The exudations of slimy or gummy substances from trees, caused by fungus attacks, wounding, and unknown causes, are known by various names according to the nature of the exudation, as *gummosis*, *resinosis*, *slimy flux*, etc. Gummosis is the exudation of a clear, amber-coloured, gummy substance, and often occurs on the Citrus family as well as on the Cherry, Almond and many other trees. It is one of the commonest diseases of the Orange, and has been attributed to numerous causes, as poor soil, bad drainage, etc. Treatment consists of thorough aeration of the soil, cutting away diseased parts, and painting with a solution of equal parts of crude carbolic acid and water, then covering the wounds with wax. The Sour-orange appears to be resistant to this disease, and should therefore be used as stock on which to bud less resistant varieties. Some exudations (*e.g.* gums, resins, balsams, etc.) are of economic importance. (See *Gums* and *Resins*.)

Malformations or **Abnormalities** are very numerous and cannot be attributed to any direct cause. Only a few of the commonest can be mentioned here. When a normally cylindrical stem or other axis becomes flattened or ribbon-like, it is said to be **fasciated.** Some fasciations, *e.g.* Cockscomb, are heritable, whilst others (*e.g.* Hevea) are not. **Proliferation** is a term used to denote a central or lateral outgrowth from a flower or inflorescence, which sometimes occurs in roses. One of the most striking malformations is the spiral twisting of the stem, known as **Spiral torsion.** This character is frequently heritable. In some cases normally coloured parts or flowers may become green, as in the case of green roses and dahlias. Stamens or sepals may become *petaloid*, as in Hibiscus, and so cause *doubling* of the flower. Two or more leaves or leaflets may arise in the place of one, as in four-leaved clover, and so on.

SPRAYING

The object of spraying is to distribute a particular fluid in a finely divided form over plants, either for the purpose of ridding them of injurious insects, or for checking the spread of fungus disease. It is carried out by means of hand-pump sprayers, " knapsack- " or other sprayers with compressed air, or by special syringes. Where only a limited number of plants have to be treated, a garden syringe with a fine rose will answer the purpose. In the case of fungus diseases, it should be remembered that spraying is essentially a preventive, which, to be successful, should

be applied at the first signs of an outbreak. Spraying operations are generally best carried out when the foliage is in a moist condition. Emulsions containing kerosene in any form should be used in cloudy weather only, or after sunset or in shade.

KNAPSACK SPRAYER.
Ejects a fine spray by compressed air.

Dangers of Spraying.—As all insecticides and fungicides are necessarily of a poisonous character, discretion must be used in applying them over fruits or vegetables that are intended for consumption as food. As the fruit approaches ripeness, spraying should be stopped. Fruit trees should not be sprayed when in blossom, as, apart from any possible danger of the poison lodging in the calyx, it may seriously affect the setting of the fruit. It is, of course, unsafe to apply any poisonous sprays to quick-maturing vegetables or salads.

SOME COMMON PLANT DISEASES IN CEYLON

These are arranged according to the plant or crop attacked. Where only the scientific name of the pathological organism is given, there is no common name for the disease. The following abbreviations are used to denote the part of the host-plant attacked: (R.) = roots, (L.) = leaves, (S.) = stems, (F.) = fruits, (Sg.) = seedlings. (B.) denotes that the pathological organism is a bacterium, (A.) an alga, (P.) that the disease is due to physiological causes.

CROP OR HOST-PLANT:	NAME OF DISEASE AND PARTS ATTACKED.
ACACIA	Armillaria fuscipes (R.); Fomes applanatus (R.); Irpex subvinosus (R.); Nectria pulcherrima, "Canker" (S.); Cercosporella Theae (L.).
ALBIZZIA	Botryodiplodia Theobromae (R.); Fomes lucidus (R.); Poria hypolateritia (R.); Ustulina zonata (R.); Nectria pulcherrima, "Canker" (S.).
BANDAKKAI	Cercospora Hibisci (L.); Oidium sp., "Mildew" (L.).
BEANS, BROAD	Uromyces Fabae, "Rust" (L.).
BEANS, FRENCH OR KIDNEY	Pseudomonas Phaseoli, "Bacterial-blight" (L., S., & F., B.); Cercospora cruenta, "Leaf-spot" (L.); Uromyces appendiculatus, "Rust" (L.); Colletotrichum lindemuthianum (F.).
BREAD-FRUIT	Sphaerostilbe repens (R.); Phytophthora sp. (F.).
BRINJAL	Fusarium sp., "Dieback" (S.); Bacillus Solanacearum, "Wilt" (S., B.); Oidium sp. "Mildew" (L.); "Little-leaf" (P.).
CABBAGE FAMILY	Plasmodiophora Brassicae, "Club-root" (R.); Pseudomonas campestris, "Black-rot" (S., B.).
CACAO	Fomes lamaoensis, "Brown Root-disease" (R.); Botryodiplodia Theobromae, "Die-back" (S.); Phytophthora Faberi, "Canker" and "Pod-rot" (S. & F.).
CAMPHOR	Fomes lamaoensis, "Brown Root-disease" (R.); Rosellinia arcuata (R.); Corticium salmonicolor, "Pink Disease" (S.).
CASTOR-OIL PLANT	Melampsorella Ricini, "Rust" (L.); Sclerotinia Ricini, "Grey-mould" (F.).

CROP OR HOST-PLANT:	NAME OF DISEASE AND PARTS ATTACKED.
CHILLIES	Rosellinia arcuata (R.); Bacillus Solanacearum, "Wilt" (R., B.); Oidium sp., "Powdery-mildew" (L.); Vermicularia Capsici (F.).
CITRUS FAMILY (Oranges, Limes, etc.)	Ustulina zonata (R.); Colletotrichum gloeosporioides, "Wither-tip" (S.); Corticium salmonicolor, "Pink Disease" (S.); Pseudomonas Citri, "Canker" (L., B.); Oidium tingitaninum, "Powdery Mildew" (L.); Macrophoma Mantegazziana (L.); Phyllosticta disciformis (L.); Cladosporium Citri, "Scab" (L.); Fusarium epithele (F.); Oospora Aurantii (F.).
CINNAMON	Exobasidium Cinnamomi (S.); Cephaleuros parasiticus-"Red-rust" (L., A.); Gloeosporium sp. (L.); Pestalozzia palmarum, "Grey Blight" (L.).
CLOVE	Fomes Caryophylli (R.); Cephaleuros parasiticus (L., A.).
COCONUT	Fomes lucidus (R.); Thielaviopsis paradoxa, "Stem bleeding-disease" (S.); Botryodiplodia sp., "Leaf-break" (L.); Helminthosporium incurvatum (L.); Bacillus coli, "Bud-rot" (B.); Phytophthora sp., "Bud-rot" and "Nut-fall" (L., S., F.).
COFFEE	Colletotrichum incarnatum, "Twig disease" (S.); Gloeosporium Coffeanum (L.); Hemileia vastatrix, "Rust" (L.).
COLOCASIA	Phytophthora Colocasiae, "Blight" (L.); Sclerotium zeylanicum (L. & R.).
COTTON	Fomes lamaoensis, "Brown Root-disease" (R.); Uredo desmium, "Rust" (L.).
CROTALARIA	Cercospora Crotalariae (L.); Colletotrichum Crotalariae (L.); Parodiella grammodes (L.); Phyllosticta Crotalariae (L.); Sphaerella Crotalariae (L.).
DADAP	Fomes lamaoensis, "Brown Root-disease" (R.); Fomes lignosus (R.); Poria hypobrunnea (R.); Coleosporium Erythinae (L.); Phyllosticta Erythrinae (L.).
DIOSCOREA	Uredo Dioscoreae, "Rust" (L.).
GREVILLEA	Botryodiplodia Theobromae (R.); Fomes lamaoensis, "Brown Root-disease" (R.); Ustulina zonata (R.).
GUAVA	Cephaleuros parasiticus (L., A.); Gloeosporium Psidii (F.).
HEVEA	Botryodiplodia Theobromae, "Die-back" (R. & S.); Fomes lamaoensis, "Brown Root-disease" (R.); Fomes lignosus (R.); Poria hypobrunnea (R.); Sphaerostilbe repens (R.); Ustulina zonata (R. & S.); Corticium salmonicolor, "Pink Disease" (S.); Gloeosporium alborubrum (S., L. & F.); Pestalozzia palmarum, "Grey Blight" (S. & L.); Phoma Heveae (S.); Phytophthora Faberi, "Die-back," "Claret-coloured Canker," "Leaf-fall" and "Fruit-rot" (S., L. & F.); "Brown Bast" (P.); Ascochyta Heveae, "Rim-blight" (L.); Cephaleuros parasiticus, "Red-rust" (L.); Colletotrichum Heveae (L.); Helminthosporium Heveae, "Birds'-eye spot" (L.); Pestalozzia palmarum, "Grey Blight" (L.); Phyllosticta Heveae (L.); Oideum sp. "Leaf Mildew" (young L.).
MANGO	Gloeosporium Mangiferae (F.); also a bacterial "Fruit-rot."
MAIZE	Helminthosporium turcicum (L.); Puccinia Maydis, "Rust" (L.).
MULBERRY	Uredo moricola, "Rust" (L.).
NUTMEG	Marasmius equicrinis, "Horse-hair blight" (S. & L.). Marasmius pulcher, "Thread-blight" (L. & S.)
PADDY	Sclerotium Oryzae (S.); Ustilaginoidea virens, "False Smut" (F.).
PAPAW	Phytophthora Faberi (F.).
PEAS	Ascochyta Pisi (L. & F.); Erysiphe Polygoni, "Mildew" (L.).
PLANTAIN OR BANANA	Fusarium sp. (S.); Marasmius semiustus (S.); also "Bunchy-top Disease" (P., S. & L.); Cercospora Musae

Crop or Host-plant:	Name of Disease and Parts Attacked.
	(L.); Glomerella Musarum (L.); Leptosphaeria Musarum (L.); Macrophoma Musae (L.); Scolecotrichum Musae (L.); Gloeosporium Musarum (F.).
Sugar . . .	Hendersonina Sacchari, "Collar-Rot" (S.); Leptosphaeria Sacchari, "Ring-Spot" (L.).
Tea . . .	Botryodiplodia Theobromae (R.); Fomes lamaoensis, "Brown Root-disease" (R.); Fomes lignosus (R.); Irpex subvinous (R.); Polyporus interruptus (R.); Poria hypobrunnea (R.); Poria hypolateritia (R.); Rosellinia arcuata (R.); Rosellinia bunodes (R.); Ustulina zonata (R.); Aglaospora aculeata, "Thorny-stem Blight" (S.); Corticium salmonicolor, "Pink Disease" (S.); Macrophoma theicola, "Branch Canker" (S.); Didymostilbe Coffeae, "Die-back" of plucked shoots (S.); Irpex destruens, "Stump-rot" (S.); Pestalozzia Theae (S. & L.); Cephaleuros parasiticus (S. & L., A.); Corticium invisum, "Black-Rot" (S. & L.); Cercospora Theae, "Birds'-eye Spot" (L.); Cercosporella Theae (L.); Colletotrichum Camelliae, "Brown Blight" (L.); Phoma theicola (L.); Rhizoctonia sp., "Collar-Rot" (Sg.).
Tobacco . .	Bacillus Solanacearum, "Wilt" (S., B.); Phytophthora Nicotianae (S.); Cercospora Nicotianae (L.); Oidium Tabaci (L.).
Tomato . . .	Bacillus Solanacearum, "Wilt" (S., B); Cladosporium fulvum, "Mildew" (L.); Oidium sp., "Mildew" (L.); Phytophthora infestans, "Blight" (L. & F.); Septoria Lycopersici (L.); Gloeosporium phomoides (F.); Vermicularia Capsici (F.); also "Leaf-Curl" (P.).
Vine, Grape . .	Cercospora viticola, "Leaf-spot" (L.); Oidium Tuckeri "Mildew" (L.); Pestalozzia viticola (L.); Plasmopara viticola (L.).

CHAPTER XXXVI

PACKING AND TRANSPORT OF PLANTS, SEEDS, BULBS, ETC.
STORING OF SEEDS.
PACKING FLOWERS, SPECIMENS, INSECTS, ETC., FOR TRANSMISSION BY POST.

The conveyance of plants or seeds over long journeys is a question which not infrequently confronts one in the tropics, and upon it much may depend in introducing new products. In cases where seeds are not procurable, or are of a particularly perishable nature, recourse must be had to live plants to meet the purpose. Unquestionably the best, though rather costly, method so far invented for transmitting growing plants over long journeys, especially by sea, is that of wardian cases, by which the transport of live plants between widely separated countries has been rendered possible. Thus the introduction of Rubber, Cacao, and other useful plants from the Western to the Eastern tropics, and others *vice versa*, is due largely to the excellent wardian cases which for many years have been sent out from the Royal Botanic Gardens, Kew, England.

A wardian case consists of a box, say 40 in. long, 24 in. wide, base 10 in. deep, sloping sides 20 in. high. It is provided with two movable sloping, glazed sides which meet at the top to form a ridge, the two ends being carried up like an inverted "V," thus Λ. The sides are fitted with glass panes set in grooves with putty and protected on the outside with narrow strips of wood, nailed on about an inch apart. A small circular hole, covered with a piece of perforated zinc, is made in each end near the top, for ventilation, and over each of these (inside) is nailed a small box which is open at the top, so as to catch any sea spray that may get in. Therefore, a wardian case when travelling is nearly air-tight, so that very little evaporation or change of air can take place within. The bottom part of the case is filled with light soil, leaf-mould, or a mixture of soil and sawdust, in which the plants are planted close together in transverse lines; these are held in position by narrow strips of wood or bamboo twigs placed across on the soil, between the plants, and secured in position by a longitudinal strip placed along on both ends of the latter and nailed to either side of the case. Light but strong wood should be used for such cases.

Wardian cases may be made of any size to suit large or small plants. When seeds are of too perishable a nature to withstand a long journey, as in the case of Cacao, they may be sown in a wardian case so as to germinate *en route*; or they may be allowed to germinate and the seedlings become established before despatch. Small bamboo twigs, without leaves, should be placed thinly over the surface, and held in position as above described, so as to allow the seedlings to grow through these while in transit.

For transport on land, or over a journey which does not involve a long sea-voyage, a simple form of case or even an improvised packing-case answers the purpose; but the plants should be firmly held in position by means of cross battens and covered with sacking or hessian securely fastened or nailed on. If the case is heavy, it should be provided with a handle at each end, or a strip of wood nailed on, so as to facilitate handling.

Dry Method of Packing.—For plants in a dormant or semi-dormant state, a dry method of packing is the best, for they will thus stand a greater degree of heat or cold than if in active growing condition. Plants which

do not naturally assume a dormant state may be prepared thus: First, get them into a good, healthy condition, each with a compact ball of roots, or, preferably, established in small pots; then harden them off by gradually withholding water and exposing them to full light.

When thus prepared, each plant is taken separately and, with roots and pot, wrapped well with moss or shavings, and tied up securely, but leaving the green part free and staking it if necessary. Taking an oblong case, the plants are laid in tiers at each end, all the foliage ends towards the centre but not quite meeting, leaving a few inches of air space; each tier is separated from the next above it by cross battens (nailed to the sides), to which the plants are fastened. The lid is then nailed down, and need not be opened again till destination is reached. A few holes may be made in the centre of the sides of the case for ventilation. The plants should not be watered before packing, and the case may be placed in any cool and dry part of the ship, preferably on the upper deck or poop, under awning.

CARE OF PLANTS IN TRANSIT

The success of any method of packing and transporting plants will largely depend upon the position and the treatment accorded to them on board-ship. Obviously they must have access to light and air, but must be under shade or cover; they should not be placed on the lower or main deck if on a long voyage, as they would thus be liable to be injured or killed by sea-spray or breakers. Any of the upper decks, except in the forepart of the ship, is therefore preferable, so long as it is not too near the engines. Plants in an active state of growth should be given an occasional watering by an intelligent person. Much also depends on season. Tropical or hot-house plants can be transported safely over long journeys during the summer months only, while deciduous plants, or those of temperate countries, *e.g.* Roses, travel best in a dormant state, as in late autumn or spring.

Treatment of Plants in transit.—Cases of live plants should be kept *under awning*, as already stated; direct exposure to the sun, especially if the cases are closed, will injure the plants. Plant-cases of whatever description should be made so as to admit of opening *en route*, enabling growing plants to be watered if necessary. A wardian-case is easily opened by unscrewing one of the glass sides. In tropical seas, during fine weather, one of the glazed sides may, with advantage, be left partly or fully open during the day, but should be closed at night. The plants may be lightly watered or sprinkled with fresh tepid water once in 2 or 3 days. In cool latitudes less watering is required, and the case should then be protected at night with a tarpaulin or other covering.

Treatment of Plants after a long journey.—When plants are received after a long journey they should, if dry, be well watered, then placed in pots or bamboo joints. They must be shaded and kept moist until well established, but heavy watering is to be guarded against until at least the plants are in active growth.

PACKING SEEDS, CUTTINGS, ETC.

For Transmission by Post

Imported seeds of annuals, vegetables, etc., of temperate countries, provided they are properly dried, travel and keep best in air-tight tins. Seedsmen who make a speciality of sending such seeds on long journeys pack them usually in a dry atmosphere, in hermetically sealed tins, so that the seeds are not affected by heat and sweat on the voyage. No packing material of a preserving kind is thus required.

Fleshy or Oily Seeds.—Tropical seeds are often of a fleshy non-driable character, naturally unadapted to a long dormant period, and are best packed with a slightly moistened absorbent material, as saw-dust, coir-dust, burnt-rice, etc. Powdered charcoal has an excellent preservative effect and is recommended for packing fleshy or oily seeds. Thus, seeds of Para rubber (*Hevea brasiliensis*), which are normally of short vitality, packed in ordinary biscuit tins, with a mixture of dry powdered charcoal and fine dry soil or coir-dust, have been transported over journeys of 6–8 weeks, and at destination gave germinative results of 70% or more. Tins or boxes containing such seeds should not be hermetically sealed, as this may cause fermentation and decomposition of the seeds.

Seeds surrounded by a mucilaginous substance, *e.g.* Cacao, *Nephelium*, *Garcinia*, etc., should be washed, partly dried in the sun, and then rolled in dry charcoal powder, which will thus form an effective preservative coating around them. Dr. van Hall records success in sending Cacao pods in paraffin wax from Dutch Guiana to Java, a voyage of over six weeks, and thus describes his method:

"The pods were first thoroughly washed with a tooth-brush and soapy water, then placed in 70% alcohol for a minute, and afterwards in a 5% solution of corrosive sublimate for a few minutes, so as to kill the germs on the surface. A piece of string being then attached to the stalk end of the pod, the latter was dipped in the paraffin (melted); it was taken out immediately and hung carefully by the string, so as not to break the thin coating of the wax adhering to it. When cold, each pod was again dipped in the paraffin, thus making the coating more complete. The pods were then packed in dry sawdust and despatched by post."

Cacao seeds, when shelled, rapidly lose their germinating power and decompose, but for journeys not exceeding about a fortnight pods may be transported in open crates; the fruits being placed vertically in tiers, and separated and held in position by thin strips of wood or bamboo, a convenient-sized crate will hold three dozen pods.

Seeds of Aquatic or Water Plants, *e.g. Victoria regia*, are best transported in small tubes or bottles filled with water or wet mud; the tube or bottle being made water-tight with wax, it may be packed with straw or shavings in a section of bamboo or wooden box, and despatched by post.

Palm seeds and most **Fruit-tree Seeds** are best packed with slightly moistened sphagnum moss, in tins, or well wrapped in oil-paper.

Cuttings, especially those of a succulent nature, as Cassava (*Manihot*), Hibiscus, Crotons, etc., may often be safely sent by post if prepared and packed in the following manner. Take healthy cuttings about 12–15 in. long, furnished with about 4 or more eyes (buds) and taken from mature stems or shoots; they must not be too slender, nor under the size of a lead pencil in thickness. See that they are not affected by any insect-pest or fungus disease. About 3 cuttings may be tied together, the ends wrapped in slightly moistened moss or fine shavings, and surrounded with oil-paper; these may be placed in a close fitting tin tube or hollow bamboo-section, wrapped in hessian, and posted. In the absence of moss, a wrapper of lint or cotton-wool slightly damped will answer the purpose. Closing up the ends of the cuttings with sealing-wax, to prevent the evaporation of moisture, or fixing the ends in a potato or other tuber, are also methods sometimes adopted with success.

Transport of Bulbs or Tubers.—These are always best transported when in a dormant or resting state. In the tropics, however, this is not always practicable, as the plants may be said to be seldom in that condition. Therefore the bulbs or tubers should be gradually dried in the sun until all the leaves have thoroughly withered, when they should be cut away. The bulbs may then be packed in dry sawdust or coir-dust, in an empty biscuit box, and sent by Parcels Post.

Packing Orchids.—Epiphytic species, which grow on trees, should be placed in layers in a box, the roots of each layer being laid in the reverse way of those of the former. Dry shavings or moss should be packed between the plants, and a few small holes bored in the box for ventilation. Keep the package in a dry, cool place. Ground (terrestrial) orchids should be partly dried, then packed in fairly dry earth or moss and wrapped in waterproof paper. For short journeys, a large leaf, as that of Banana (Musa), Heliconia, etc., answers the purpose of wrapper. Avoid as much as possible an air-tight condition or excessive moisture, which will lead to fermentation and decomposition. Evergreen ground-orchids, as *Anoectochilus* (Wana-raja), should be placed upright and firmly secured in position, with free space for the leaves, which should not be removed. Empty biscuit-tins with perforated sides are useful for sending small orchids like these by post. Do not disturb the roots of any orchids more than necessary when packing for transport; it is preferable to send if possible a portion of the material to which the growing roots are attached. Do not pack too many plants together.

Packing and Despatch of Flowers.—Flowers should be cut with a sharp knife,

not broken off; cutting with scissors is apt to press and close the tubes of the stalks, thereby preventing the absorption of moisture when placed in water. Cut the flowers in the early morning, when they are full of moisture; when packing, do not sprinkle water on them, and if wet, shake them gently. In packing, the box should be lined with oil-paper, moss, or fresh leaves; no cotton-wool or similar absorbent substance should be used as packing, the best material for the purpose being moss or fresh leaves. The flowers should be packed quite closely together, for they will shake down in transit, and if loose the jolting will bruise them; they are best not tied in bunches, except in the case of small flowers, as violets. A tin box, rather shallow, or, if deep, provided with movable trays, is the best receptacle for sending flowers long distances either by rail or post, but a stout card-board box may answer the purpose if strong enough.

Sending Specimens by Post or Rail.—It being important that these should arrive in as fresh a condition as possible, they should be packed in a closely fitting tin or wooden box without air holes, both for the purpose of keeping them fresh and preventing the escape, if present, of insects or injurious fungus spores. Specimen plants for identification may be spread flat and thinly between blotting-paper. Ample material should be allowed for full examination, and when flowers or fruit are available they should accompany the specimen, as in many cases these are essential for identification. Full notes of the locality from which the specimen comes, with elevation, etc., should be given. Such parcels should always bear the name of the sender.

Transmitting Insect-pests by Post.—Small insects may be enclosed in a cigarette-tin for despatch by post, a few leaves being enclosed with them both for the purpose of food and preventing damage by shaking during transit; loose pieces of wood or earth should not be included in the case of insects which may be injured by these. If holes are made in the tin or box for ventilation, they should not be large enough to allow the insects to escape. The address and postage-stamp should be on a separate label attached to the package, which should also bear the sender's name.

Transporting Live Fish.—The fish should be caught with great care, as by a net, then transferred immediately to barrels or tubs containing fresh water, which should be ready at hand. It is not advisable to place many fish in one vessel. During transport, fresh water should be frequently added to the vessel or, where this is not practicable, the water should be kept aerated, as with a syringe or a bicycle inflator, which should be dipped every ¼ of an hour into the water and pumped for 2 or 3 minutes. The process should be continued until the fish are deposited in a pond or tank.

STORING OF SEEDS

Except for convenience, it is perhaps never advisable to keep seeds for a long time, as most, if not all, seeds germinate best when fresh, provided they are perfectly matured. All seeds may be classed as dryable or non-dryable (see *Seeds*). To the latter belong a large proportion of seeds of tropical species, and these are best sown soon after they are ripe. Their vitality may usually, however, be prolonged for a limited period by placing them in a dry porous mixture, such as charcoal, burnt paddy-husk, coir-dust, saw-dust, or finely sifted dry soil, etc.

Grains, pulses, and small dryable seeds, if properly matured and dried, are best kept in stoppered bottles or air-tight tins until required, being thus afforded protection from weevils and other destructive insects, as well as from the baneful effects of damp and mould. Imported seeds, especially those of annuals and vegetables, which may not be sown immediately after arrival, should always be stored in air-tight vessels, as stated, and kept in a cool place until required; or better still, they may be laid over calcium chloride in desiccator jars. Where this is impracticable, as in the case of paddy and other grains stored in bulk, naphthalene balls placed among the seed are a good preventive against weevils and other insects. (See *Insecticides.*)

CHAPTER XXXVII

RECIPES FOR JAMS, JELLIES, PRESERVES, ETC.
USEFUL REFERENCES.
NATIONAL FLORAL EMBLEMS.
TABLE OF SEED WEIGHTS, ETC.
WEIGHTS AND MEASURES.

JAMS

These recipes have been contributed by experienced ladies.

Billing Jam.—Prick the fruit well over with a fork; let it soak in a basin of water for a night. Then squeeze the fruit slightly to get rid of some of the acid juice; throw away the liquid, and boil the fruit with its weight of sugar until it is of the proper consistency. (See *Preserves.*)

Camaranga or Carambola Jam.—Cut off and discard the sharp edges; then cut into pieces about ¾ of an in. thick; for 2½ lb. of fruit add 1½ pints of water; boil till tender, which will take about 15 mins., then add 2 lb. best granulated sugar, and boil for 15 or 20 mins. The small seeds are considered to improve the flavour.

Cape Gooseberry or Tippari Jam.—Wash the fruit and put in a pan with sugar, allowing a cupful of sugar to every cupful of fruit; add a cupful of cold water, and boil till done. This makes a delicious jam. (See *Jellies.*)

Melon Jam.—For every 18 lb. of fruit allow 12 lb. of sugar, 6 lb. lemons, ¼ lb. bruised ginger tied in a muslin bag. Peel fruit over night and cut into small squares; put into a large basin (after weighing), and sprinkle over a little of the sugar. Next morning, put into the preserving pan with the remainder of the sugar; while this is boiling, pare the lemons and squeeze out the juice; strain the latter and add to the melon. Put the lemon rinds on to boil in plenty of water, and when they become soft cut into strips with a sharp knife and add to above. Boil for 4 hrs., and remove the ginger bag. This is also known as "Lemon and Melon Jam."

Papaw Jam.—Choose fruit three-quarters ripe; remove all skin and seeds; chop up the fruit into small pieces. Weigh, add equal weight of sugar, also some green ginger (cut into small slices), 2 oz. of the latter being sufficient for 6 lb. of fruit. Cover up the fruit and sugar, and let the latter dissolve during the night. Boil up the next morning until done.

Passion-fruit Jam.—Have two basins ready; cut the fruit in halves, scoop out all the juice and seeds into one basin, putting the shells in the other; cover the latter with cold water, add a pinch of salt, and leave for 12 hrs.; then boil in the same water for three-quarters of an hour, remove the inside of the shells, throwing away the outside skins and the water they were boiled in. Squeeze out the juice from the seeds, and discard the latter. Mix the rest together and boil for half an hour, allowing 1 lb. sugar to 1½ lb. fruit.

Peach Jam.—Pare and stone the fruit; then weigh and allow 10 lb. of sugar to every 12 lb. of fruit. Put the latter in a preserving pan and barely cover with water; allow this to cook slowly for 1½ hrs., at the end of which time add the sugar, and cook for an hour longer.

Pineapple Jam.—Peel the pineapples and chop into small pieces (discarding cores); weigh the fruit, and allow 1 lb. sugar per 1 lb. of the latter; boil until of the desired consistency. A piece of ginger added will improve the flavour.

Orange Marmalade.—Take 1 lb. oranges, 3 pints water, 3 lb. sugar. Halve and quarter the oranges; take out cores and seeds, then slice very thinly and soak in water for 24 hrs.; boil in that water until the marmalade is of amber colour. When it has boiled for 20 mins., add the sugar and let boiling continue till it jellies.

Rozelle Jam.—Wash 6 lb. of the unripe fruit (fleshy calyces), cut open and remove the centre and seed, when the weight of the fruit will be about 3 lb. Add 2 cups of water and cook for about an hour, or until reduced to a soft pulp; when

cooled, measure the fruit and for each cupful add 1¼ cups of sugar; cook for 20 mins. 6 lb. of rozelle should thus make 7 lb. of jam. (See also *Jellies.*)

JELLIES

Cape Gooseberry or Tippari Jelly.—Boil and strain the fruit, put the juice on fire to simmer; skim, add sugar in the proportion of 3 or 4 parts to 1 part juice (or to taste), and cook till it jellies. (See also *Jams.*)

Guava Jelly.—After thoroughly washing the fruit, put them in an enamelled saucepan with sufficient water just to cover; boil until all the fruit is broken, then strain; to one breakfast cupful of juice add the same quantity of sugar or slightly more (say 6 cupfuls juice to 6½ of sugar), and boil very slowly. A little lime-juice may be added after the sugar is put in.

Lovi-lovi Jelly.—Boil the fruits thoroughly and remove the scum as it comes up. Then strain, and boil with refined sugar (two to one) till it forms a jelly.

Nutmeg Jelly.—Take 3 lb. nutmeg skins and 4 lb. sugar. Peel the skins and put into water for 12 hrs.; then take them out and place in enough water just to cover them, and boil until quite mashed; strain off the juice, add the sugar, and boil slowly till it jellies.

Another Recipe.—Put the rinds of ripe nutmegs into a preserving pan, with just enough water to cover them; boil until the rinds are almost a pulp; then strain through a flannel jelly-bag. To every pint of juice add 1 lb. sugar, and boil until it jellies.

Rozelle Jelly.—Place the fruit in a basin and barely cover with water; allow to soak all night, and in the morning slightly squeeze the fruit; place all in a preserving pan, and boil until quite soft and pulpy. Then let the juice drip slowly through a jelly-bag. Allow 1 lb. sugar to 1 pint juice; boil all slowly for 15 or 20 mins., or until a jelly is formed.

PRESERVES, FRUIT SALADS, ETC.

Billing Preserve.—Prick the fruits with a fork and place in water for a few hours; then slightly squeeze the fruits, wash with hot water, and dry with a towel. Sugar (in the proportion of 1½ lb. to 1 lb. fruit) should be boiled separately and refined as for "Nelli Preserve"; add the fruits to the sugar, and boil till the latter becomes a thick syrup. (See *Jams.*)

Camaranga Preserve.—Cut off the ends and sharp ridges of the fruit; prick the latter with a fork, and place in cold water for a few hours. Squeeze out and pass through hot water before putting the fruits into the sugar-syrup, and boil as other preserves. Proportion of sugar, 2 to 1 of fruit. (See *Jams.*)

Cashew-nut Toffee.—Take 2 lb. sugar and 150 cashew-nuts; skin the latter like almonds, in hot water, and chop up with a knife or mincing machine. Make a syrup of the sugar with 2 tumberfuls of water, then add nuts and cook till the whole crystallizes; place on a buttered plate and, when partly set, cut into squares or diamond shapes.

Mango Preserve.—Take mangoes which are ¾ ripe, peel off skins and cut flesh into slices, discarding the seed. Prick with a silver fork, and soak in cold water for a few hours. Prepare sugar (1½ lb. to 1 lb. fruit) as for "Nelli," and boil till cooked.

Nelli Preserve.—Pick fruits when half-ripe; wash, and prick all over with a silver fork. Squeeze the juice out by hand, and soak in cold water for about 12 hrs.; put the fruits in boiling water for a little while, and again squeeze out the juice. Add sugar in the proportion of 2 lb. to 1 lb. of fruits; boil sugar separately, then add the fruits and boil till all becomes a thick syrup.

Pineapple Preserve.—Slice and cut the fruit in small cubes, but do not squeeze out the juice. Then boil with refined sugar (one to one) as for "Nelli"; add a small piece of ginger and a few cloves to flavour.

Pumpkin Toffee.—This is made like cashew-nut toffee, allowing 1 lb. sugar per 1 lb. of pumpkin, grated like coconut; add ¼ lb. of flour and, when it begins to crystallize, a table-spoonful of butter. When set, cut into squares.

Mango Chutney.—Take 1 lb. of mature but not fully ripe mangoes, 1 lb. Demerara sugar, ½ lb. sultanas, 2 oz. almonds, 2 oz. garlic, 2 oz. dried ginger, 2 oz. dry chillies, and a little salt. Peel the mango, slice from the seed and cut into small pieces; chop the sultanas and almonds; grind the garlic, ginger and chillies on a curry stone. Mix all with a pint of malt vinegar, and boil for 20 mins., stirring all the time.

Devilled Bananas.—Melt 1 table-spoonful of butter, add ¼ tea-spoonful of chopped red chillies, 2 tea-spoonfuls chopped pickles, 1 tea-spoonful Worcester sauce, and ¼ tea-spoonful of salt. Add 4 bananas, each cut in 4 equal parts, and cook for 5 mins.

Fruit Salad.—Peel and clean with a silver knife any fruit available, as pineapple, mangoes, plantains, oranges, papaws, etc. Slice the fruit, cut into neat squares in suitable proportions, and place in a glass dish. Sprinkle with castor sugar; mix well and add some hock or sherry. Fresh whipped cream (as Fussel's tinned cream), mixed with sugar and vanilla, or a good custard, should be served with this salad.

Wood-apple Drink.—Take 6 wood-apples (*Feronia*), 1 coconut, and some jaggery. Scrape out the inside of the wood-apples; squash the pulp well and strain through a sieve. Break the coconut in two, scrape out the inside, add cold water, and squeeze out the milk—mix some of the latter with the wood-apple to pass it through the sieve. Scrape the jaggery finely with a knife and add to the liquid according to taste. Add the rest of the coconut milk till the drink becomes as thin as desired.

Vegetable Curry.—Take 3 carrots, 3 turnips, 3 potatoes, 1 onion, 2 table-spoonfuls curry-powder, 1 apple, and some boiled rice. Scrape the carrots and cut in slices; peel the turnips, potatoes, onions and apple, cut these in slices and fry in butter until a nice brown; put all in a deep pie-dish; mix the curry powder with a ½ pint of stock, and pour over the vegetables; cover the dish with a plate, and simmer in the oven for 1 hour.

Cooking Potatoes.—Potatoes boiled in their jackets lose 1% of their protein (flesh-forming substance), 3% of their ash, and practically no starch. Plunged into boiling water after peeling, then boiled, they lose 8% protein and 18% ash. Placed in cold water after peeling, and boiled, they lose 15% protein, over 18% ash, and 3% starch. Slow cooking is desirable, and steaming, as with vegetables generally, is better than boiling.

Tomato Soup.—In most warm countries tomatoes may be easily grown, and they make a delicious soup. Recipe: take ripe tomatoes at the rate of 1 lb. fruit to 1 pint water. Boil together until tomatoes are tender; then pass through a hair sieve. Mix to above proportions 1 spoonful of flour, made into a paste with water and ¾ pint of milk. Stir well, boil, and serve hot.

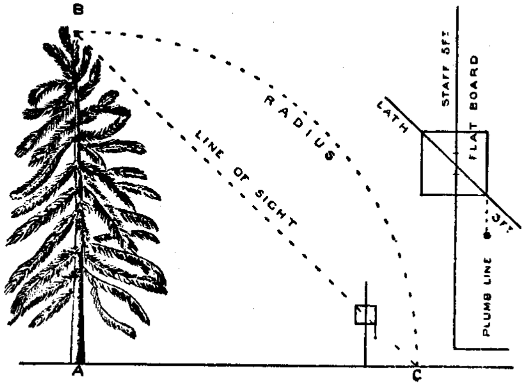
USEFUL REFERENCES

To Make Charcoal.—Cut the wood in lengths of 2–3 ft., and split into pieces 2–3 in. in thickness. Heap these into a wide pit, leaving an open space in the centre to serve as a chimney; pile the wood around this, one piece upon another, laid as closely as possible. Cover the whole with grass or leaves, and then with turf or adhesive earth, except the top of the chimney; start the fire in the chimney at the base with dry kindling. Carefully stop all outbursts of flame with earth, and close or open the draught holes (left at the base) according as the fire burns. When the fire is completely extinguished, allow the mass gradually to cool. On an average 1 cubic yard of wood should give 3 bushels charcoal.

Woods for Charcoal.—Hard woods as a rule make the best charcoal, as they contain less water than soft woods; therefore dry-zone woods, being generally the hardest, are best adapted for charcoal-making. The following are some of the woods most commonly used in Ceylon for making charcoal: *Acronychia laurifolia* (Ankenda, *S*), *Adenanthera pavonina* (Madatiya, *S*), *Artocarpus nobilis* (Del, *S*), *Bassia longifolia* (Mee, *S*), *Calotropis gigantea* (Wara, *S*), *Caryota urens* (Kitul, *S*), *Croton lacciferus* (Keppetiya, *S*), *Doona zeylanica* (Dun, *S*), *Hemicyclia sepiaria* (Vira, *S*, or Viyarai, *T*), *Trema orientalis* (Gedumba, *S*; Charcoal-tree), *Vitex altissima* (Milla, *S*), *Wendlandia notoniana* (Rawan-idella, *S*). *Acacia arabica* and *A. Catechu* are commonly employed in India for making charcoal used in gunpowder, etc. Coconut-shell charcoal is of commercial importance in Ceylon, from which considerable quantities are now exported, chiefly to France but also to the United Kingdom, India, etc., being valued at about 3*s*. to 4*s*. per cwt.

Measuring Height of Trees.—Take a staff 6 ft. long, pointed for pressing into the ground. To the centre of the staff fix with screws a piece of board 12 in. wide and exactly square. Fix to this diagonally a strip of straight lath. A plumb line is attached to the staff so as to enable the perpendicular to be obtained; this is important. In measuring a tree the staff is placed at a distance from it, so that, with the plumb exactly perpendicular, the diagonal lath points to the top of the tree, the person taking the "sight" resting on one knee or reclining to bring the

eye to the lower end of the lath. The sight line is then extended to the ground by means of a string. From the point where this touches the ground (C in figure) to the centre of the trunk at the base will represent the actual height of the tree; that is, the horizontal line AC is equal to the vertical AB of the triangle. If the tree were blown over or cut down, its top would follow the course shown by the curved line, and rest at C.



Dendrometer for Measuring Height of Trees.

Another Method.—Make two lines on the ground exactly 3 ft. apart. On one of the lines drive a stake in the ground so that the top of the stake will be exactly 3 ft. from the ground; when the shadow of the stake will have reached the other line, the shadow cast by the tree will be precisely the length of the height of the latter, and by measuring the length of the shadow at that moment you will obtain the height of the tree. The measurements should be taken on level ground. If the tree is leaning, incline the stake to as nearly the same angle as possible at which the tree inclines.

Stink-woods, etc.—In warm countries various trees, fruits, or flowers are noted for their objectionable odour, as, for example, the Durian fruit of Malaya (*Durio*); the flowers of certain species of Terminalia, e.g. *T. melanocarpum* or Stink Tree of Queensland; the wood of *Celtis cinnamomea*, "Gu-renda" or Stink-wood of Ceylon; the wood of *Ocotea bullata*, or Stink-wood of S. Africa. *Fœtidia mauritiana* is the Stink-wood of Mauritius, and *Erygium fœtidum* is the Stink-weed of Trop. America. Flowers which are characterised by a disagreeable odour are sometimes called Carrion-flowers, as *Aristolochia* spp., *Amorphophallus* and other Aroids. The common Ageratum (*A. conyzoides*) is known in Ceylon as "Goat-weed" on account of its disagreeble smell, and by the Tamils as "Pum-pillu," which denotes this quality.

Rainfall.—The depth of rainfall in inches, multiplied by 3,630, equals number of cubic feet per square acre; multiplied by 22,623, equals number of gallons per square acre.

Thus :—

Inches.		Cubic feet per acre.		Gallons. per acre.		Tons per acre.
1	=	3,630	=	22,635	=	101·1
2	=	7,260	=	42,270	=	202·2
3	=	10,890	=	67,905	=	303·3
5	=	18,150	=	113,174	=	505·5

1 Cu. ft. of water = $6\frac{1}{4}$ gall. = $62\frac{1}{2}$ lb. = 1,000 oz. = about $\frac{3}{4}$ bushel. 40 × 10 × 10 ft. (4,000 cu. ft.) = 26,000 gall. 1 Cu. in. of water = $\frac{3}{5}$ oz. by weight. 1 Pint of water = 20 oz. by weight. 1 Gall. of water = 10 lb. by weight. 1 Ton of water = 224 gall.; 1 oz. water = 1 oz. by weight. 1 lb. water measures $27\frac{3}{4}$ cu. in. 1 Ordinary tumbler holds 10 liquid oz. 1 Table-spoon holds $\frac{1}{2}$ liquid oz. 1 Tea-spoon holds 1 liquid drachm or 60 drops. 4 Tea-spoonfuls = 1 liquid oz.

Woods for Cart-wheels.—The woods most generally used in Ceylon for making cart-wheels are: "Hal-milla" (*Berrya ammonilla*), "Milla" (*Vitex altissima*), "Suriya" (*Thespesia populnea*), "Pihimibiya" (*Filicium decipiens*), and "Ratu-wa" (*Cassia marginata*). The usual quantity required for and cost of 2 full-sized ordinary cart wheels of $4\frac{1}{2}$ ft. diameter are: 12 pieces for rims @ Rs. 1 each; 24 spokes @ 70 cents, hubs @ Rs. 6, total for two wheels Rs. 40·00. Iron tyres, bushes, etc., about Rs. 40 extra, say Rs. 85·00 in all, including labour. The cost of a double bullock-cart complete with wheels and hood is about Rs. 150·000 (= £11).

To Revive Flowers.—Rinse the stalks in fresh warm water and put into warm salt-water, to which has been added a few drops of ammonia or a little copper sulphate. As each flower is ready to be placed in the vase of fresh water, snip off a small portion of the stalk with a sharp pair of scissors. To keep sprays of flowers or ferns fresh, place them on damp cotton-wool or moss under an inverted basin, in darkness or shade.

Preserving Specimens.—For preserving specimens of fleshy fruits, as cacao, nutmegs, etc., or other fresh vegetable matter of all kinds, as for museum purposes: immerse specimens for 5 mins. in a 20% (2 in 10) solution of formalin, then remove and place in a solution of about 8 or 10% strength. If the formalin is used too strong, it will deprive the specimens of their colour. Herbarium specimens are more easily dried and prepared if first dipped in a 10% solution of formalin for 2 or 3 mins. before starting to dry. Formalin solution has certain advantages over alcohol for preserving purposes; it is not so liable to discolour the specimens and, not being inflammable, does not involve risk of fire. For preserving specimens for purposes of dissecting or section-cutting, a solution of alcohol is best, a strength of about 25–30% usually being sufficient.

To Prepare Skeleton Leaves.—Mix about one drachm chloride of lime with 1 pint water, adding sufficient acetic acid to liberate the chlorine. Steep the leaves in this until they are whitened (about 10 mins. should suffice), taking care not to leave them too long. Then place in clean water, floating them out on sheets of paper placed underneath. Lastly, remove the fronds from the paper before they are quite dry, and place in a book or press. They look best when mounted on dark paper.

To Preserve Fern Fronds.—Reject very young fronds, as they will lose their colour in drying. Place the selected fronds between several sheets of blotting paper, and over this pass a moderately heated flat iron for several minutes. Practice only will determine how long to continue the ironing, as ferns vary in the thickness of their fronds. Then place separately in a book, and lay aside for a day or two previous to mounting. To do this, smear the sheet or paper over with liquid gum, lay the reverse side of the frond on the gummed surface, press gently, remove frond, and place carefully on a clean sheet of paper where you intend it to remain. Finally pass over a piece of blotting paper to remove creases and absorb excess of gum.

To Drive Away Sparrows from Eaves, etc.—Smear a few thin twigs with any sticky substance, as bird-lime, seccotine, or the resinous gum from jak-fruit; place these at intervals where the sparrows collect, and they will soon disappear.

To Make Bird-lime.—Boil $\frac{1}{2}$ pint linseed oil, and while boiling add a lump of resin about the size of a hen's egg. Add two tea-spoonfuls of treacle, and stir frequently while cooling.

Golf Greens.—For making golf-greens, see *Lawns*. Crickets, ants, crabs and other burrowing creatures are sometimes very troublesome on golf links. An application of a ground insecticide (*q.v.*) will probably be found an effective deterrent. Another simple remedy is to pour some kerosene or liquid-fuel down their burrows.

Soft-soap Recipe.—Soft-soap may be made as follows: Dissolve 20 lb. of caustic potash (commercial) in 4 gall. of hot water; when cold, pour the solution slowly into 9 gall. of cotton-seed oil (gingelly- or coconut-oil will also answer the purpose), stirring until the potash and oil have become thoroughly combined. If too thick, add hot water to bring the mixture to the desired consistency.

A Simple Fly-trap.—Pour some water into a finger-bowl or other wide-mouthed vessel till the surface of the liquid is about an inch from the brim. Add a small quantity of oil (coconut- or castor-oil) to make a superficial film. In the centre of a piece of cardboard, sufficiently large to cover the vessel, cut a small hole about $\frac{1}{2}$ in. in diameter. Smear some condensed milk or honey on the underside of the cardboard round the central aperture. The flies will creep into the enclosed space and meet with an oily grave. A tap on the card will at once precipitate any that are resting on its under surface. The oil-film is necessary, as flies are not easily wetted by water, from which they may escape.

Cockroaches.—Special traps for use in catching these are obtainable, but they are not always reliable. Powdered borax is usually an effective and safe material to use. Mix this with sugar and scatter in places frequented by the cockroaches, and they will soon disappear.

Bee or Wasp Sting Remedy.—For allaying the pain from these the following hints are effective. Keep the part as cool as possible, as cold checks the activity of the poison; therefore apply to the part any cold substance at hand, as a stone, cold

water, cut surface of a raw onion or potato, in case none of the following is at hand, viz.: laudanum, ammonia, vinegar, or salt. As animal poisons deoxidise the blood, their antidote will be anything that contains much oxygen. Keep the body at rest and avoid agitation. A little ammonia or some brandy may be given at once.

Book Preservative.—The following makes an excellent preservative for books, as well as a preventive against insects and moulds, which are so destructive to books in the tropics: dissolve Canada balsam in turpentine, say 2 oz. of the former to 4 oz. of the latter, so as to make a weak solution; paint this evenly and thinly over the covers or bindings of the books, and let them stand a few hours to dry.

Another Recipe.—Paint the books lightly over, both outside and inside the cover, and especially along the back where paste has been used, with the following solution, using a soft brush for the purpose: 1 oz. corrosive sublimate, 1 oz. carbolic acid, 2 pints methylated spirit. No harm will be done to the books, and after the mixture has dried they may be handled with perfect safety.

Measuring Land.—The following lengths, multiplied by the breadths opposite, equal an acre (4,840 sq. yds.):—

968 yds. long and	5 yds. wide.	110 yds. long and	44 yds. wide.
484 „ „	10 „	88 „ „	55 „
220 „ „	22 „	69½ „ „	70 „
121 „ „	40 „		

A yard is a good stride; few men step a full yard in their natural stride.

144 sq. in. (12 × 12 in.) = 1 sq. ft.; 9 sq. ft. (3 × 3 ft.) = 1 sq. yd.; 30¼ sq. yd. (5½ × 5½ yd.) = 1 rod, pole or perch; 40 rods, poles or perches = 1 rood; 4 roods or 4,840 sq. yd. = 1 acre; 640 acres = 1 sq. mile. (See p. 488.)

To Measure Timber in Log.—Take the girth in inches in the middle, divide by 4 and square the result, which gives the mean sectional area of the trunk; multiply the product by the length of the log in feet, divide by 144 and the quotient is the sum of the contents in cubic feet. Where there is bark, an allowance must be made for this, the usual allowance varying from ½ to 1½ in. to every foot of quarter girth; thus, the total quarter girth being 24 in., and the bark being thick, a deduction of 2 or 3 in. would be necessary, the quarter girth being taken at 21 or 22 in.

To Measure Sawn Timber.—When the thickness of timber is 1½ in. or less, multiply length in feet by width in inches and divide by 12. When over 1½ in. thick, add width and thickness together, multiply by length in feet and divide by 12. To ascertain number of superficial feet of board 1 in. thick that may be cut from a log: take average girth of latter (*i.e.* the girths at both ends and centre added together and divided by 3) in inches, multiply by length in feet and divide by 12.

Weight or Measurement of Straw or Hay Stacks.—To measure an oblong stack, multiply the length in feet by the width below the eaves, and the product by the height from the ground to the eaves. For the top, multiply the length in feet by the width at the eaves, and the product by half the length to the ridge. A cubic foot of hay weighs approximately from 7 lb. to 9 lb. For general purposes the weight of a stack may be ascertained by actually measuring the cubic contents of a truss, and calculating from this the weight per cubic foot. Stacks of straw are estimated at from 18 to 20 cu. yds. to a ton.

To Estimate Grain Crops per Acre.—Frame together four light sticks, measuring exactly a foot square inside, and with this in hand walk into the field and select a spot of fair average yield; lower the square frame over as many heads as it will enclose, shell out carefully the heads thus enclosed, and weigh the grain. To make the result more reliable, make ten or twenty similar calculations, and estimate by the mean of the whole number of results.

Approximate Cost per Acre of Bringing Crops into Bearing, in Ceylon.—Coconuts, £25 up to 6th year; Tea, £30 to £35 up to 4th year; Cocoa, £25 to £30 up to 5th year; Rubber, £30 up to 6th year. These figures include the necessary factory or store, but not the cost of land. From £4 to £6 more per acre may be allowed, under average conditions, for the Straits Settlements and F. M. S.

Road-making and Concreting.—A cube of road metal is 18 ft. long at base, 5 ft. broad, 2½ ft. high in centre and 14 ft. long along top ridge. It contains 60 bushels of metal which, when spread, is sufficient for metalling about 500 sq. ft. of road surface. Usual cost at quarry, in Ceylon, about Rs. 8. Concrete metal is 50% finer (= road metal broken in half); cost per cube at quarry, Rs. 12·50. The usual charge for concreting, 4 in. thick, varies from 25 cents per sq. foot, according to locality.

Average Day's Work per Cooly:

Holing, 18 × 12 in., as for Tea	100–120 holes.
Planting Tea	200–250 plants.
Drains, 18 × 15 in.	50– 60 ft.
Pruning Tea	180–250 trees.

Cadjans, the plaited leaves of the coconut palm; used for thatching houses, making cart-hoods, shading plants, etc., also for making temporary cheap baskets for transport of plants, fruits, etc. Each leaf, split along the centre, makes two cadjans. An expert cooly can plait 75 cadjans a day, and the usual charge for these in Ceylon is from Rs. 10 to Rs. 25 per thousand, according to locality; the higher prices rule in the vicinity of towns.

Tennis Court Dimensions.—Outer lines (court) 78 × 36 ft., inner lines (court) 42 × 27 ft.; the two long lines of the latter are extended to the end lines of outer court. A line is placed across the centre, joining outer lines, and another line placed lengthwise in centre of inner court only. Height of net in centre should be 40 in., or 1½ lengths of a racquet.

Badminton Court Dimensions.—44 × 22 ft. divided by a net 5 ft. high. A service line on each side of the net and parallel to it at a distance of 6½ ft. A central line connecting the service and base lines divides those areas into 4 courts. Unlike tennis, no fault is allowed in serving.

Clock Golf.—Form a circle with a diameter of from 25 to 30 ft. on a smooth lawn. Divide the circumference into twelve equal parts, and number the divisions like the dial of a clock. Sink a hole 4¼ in. across and 4 in. deep, at a spot inside the circle, near the figure 6 on the dial, placed so that no two of the twelve points are at exactly the same distance from it. The art of the game is to "put" a golf ball into the hole in the fewest possible number of strokes, playing from each of the twelve points around the circle in turn.

Ladder Golf.—Mark 2 parallel lines, about 40 or 50 ft. long and 2½ ft. apart, on a smooth portion of lawn; mark cross lines in 4 pairs at varying distances apart, those forming each pair being 15 in. distant. Number each pair, and make a round putting-hole (4¼ × 4 in. deep) on the top rung of the ladder. The ball is "put" from the base line to each pair in turn, the fewest number of strokes winning the game. If the ball overruns the side lines or the second line of a pair, it must be "put" again from where the last shot was played, and one is added to the score as penalty.

NATIONAL FLORAL EMBLEMS

Australia.—Wattle (*Acacia* spp.).
Canada.—Sugar Maple (*Acer saccharum*).
Ceylon.—Talipot Palm (*Corypha umbraculifera*).
Egypt.—Lotus-lily (*Nelumbium speciosum*).
Holland.—Tulip (*Tulipa gesneriana*).
Ireland.—Shamrock (*Trifolium repens*).
Italy.—Lily (*Lilium* spp.).
Japan.—Yellow Chrysanthemum (*Chrysanthemum sinense*, var.).
England.—Rose (*Rosa* spp. or vars.).
France.—Fleur-de-lis (*Iris germanica*).
Germany.—Cornflower (*Centaurea Cyanus*).
Greece.—Violet (*Viola odorata*).
Scotland.—Thistle (*Onopordon Acanthium*).
Spain.—Pomegranate (*Punica granatum*).
Belgium. / **Switzerland.** } Poppy (*Papaver somniferum*).
Wales.—Daffodil or Leek (*q.v.*).

TABLE SHOWING APPROXIMATE WEIGHT OF SEEDS

When Fresh but Partially Dried, and usual Number in each Fruit.

Name.	Number to an oz.	Number to a lb.	Number in each Fruit
Acacia decurrens. Wattle-bark	1,500	24,000	10
Acrocarpus fraxinifolius. Shingle Tree	800	12,800	10–12
Adenanthera pavonina. Madatiya, *S*	100	1,600	8
Agathis alba. White Dammar	260	4,160	20
Albizzia moluccana. Albizzia	1,150	18,400	15
Anona squamosa. Sugar-apple	85	1,360	30
Arenga Wightii. (Palm)	8	128	2–3
Artocarpus integrifolia. Jak	5	80	180–280
Barringtonia speciosa. Mudilla, *S*	—	2 (fruits)	1

Name.	Number to an oz.	Number to a lb.	Number in each Fruit.
Bauhinia triandra	80	1,280	10
Bignonia unguis. (Climber)	216	3,456	184
Bombax malabaricun. Red Cotton-Tree	220	3,520	100
Brownea grandiceps	2	32	4
Caesalpinia coriaria. Divi-divi	600	9,600	2
C. Sappan. Sappan-wood	50	800	6
Cajanus indicus. Rata-tora, *S*; Pigeon Pea	280	4,480	4–6
Camellia Thea. Tea	14	224	2
Camphor. See *Cinnamomum.*			
Canaga odorata. Ylang-ylang; Wanasapu, *S*	400	6,400	5
Canarium commune. Java almond (Dried fruits)	4	64	1
C. Mehebethene. (Moluccas)	2	32	1
Carapa guianensis. Crapa	2	32	8
Carica Papaya. Papaw	500	8,000	Few or many.
C. candamarcensis. Mountain Papaw	800	12,800	150
Caryota urens. Kitul; Toddy Palm	25	400	2
Cassia Fistula. Ehela, *S*	8	128	20
C. grandis. Horse Cassia	46	736	40
C. nodosa. Pink Cassia	100	1,600	22
Castanospermum australe. Australian	—	15	23
Castilloa elastica. Panama Rubber	50	800	20–25
Casuarina equisetifolia. Beef-wood	6,500	96,000	50–60
Casuarina montana	5,000	80,000	40
Cedrela serrulata	5,000	80,000	18–20
Chenopodium ambrosoides	10,000	160,000	—
Chrysalidocarpus lutescens. (Palm)	25	400	1
Chrysobalanus Icaco. Coco-plum	5	80	1
Cinchona (*q.v.*)	30,000	480,000	—
Cinnamomum Camphora. Camphor	200	3,200	1
C. zeylanicum. Cinnamon	50	800	1
Citrus Aurantium. Orange	100	1,600	6–10
C. nobilis. Mandarin Orange	120	1,920	12
Coffea arabica. Arabian Coffee	60	960	2
C. liberica. Liberian Coffee	45	700	2
Cola acuminata. Kola-nut	1–2	23	4
Cotton. See *Gossypium.*			
Crotalaria striata	205	3,280	45
Croton Tiglium. Croton-oil Plant	130	2,080	3
Cupressus macrocarpa. Cupressus	2,600	41,600	65
Cycas circinalis. Madu, *S*	1	16	1
Cyphomandra betacea. Tree-tomato	2,400	38,400	110
Cyrtostachys Renda. (Palm)	250	4,000	1
Dalbergia Sissoo. Shishum	1,400	22,400	—
Detarium senegalense	2	32	1
Dimorphandra Mora. Mora Tree	—	4	1
Dichopsis pustulata	13	208	1
Dodonea viscosa	2,000	3,200	—
Duranta Plumieri. Duranta	52	832	6
Durio zebithinus. Durian	1–2	23	10
Elaeocarpus Ganitras	10	160	1
E. edulis. Ceylon Olive	5	80	1
Enterolobium cyclocarpum	24	384	5–6
Eriodendron anfractuosum. Kapok	315	5,000	120
Erythrina lithosperma. Dadap	80	1,280	3
Erythroxylum Coca. Coca- or Cocaine-plant	240	3,840	1
Eucalyptus citriodora. Lemon-scented Gum	6,500	104,000	120
E. globulus. Blue Gum	300	116,800	—
Eugenia caryophyllata. Clove	19	304	1
E. malaccensis. Rose-apple	6	96	1

Name.	Number to an oz.	Number to a lb.	Number in each Fruit.
Filicium decipiens. Pehimbiya, *S*	32	512	1
Flacourtia inermis. Lovi-lovi	800	12,800	10
Garcinia Cambogia. Goraka, *S*	48	768	3
G. Mangostana. Mangosteen	11	176	1–3
G. Xanthochymus. Cochin-goraka	4	64	3
Gliricidia maculata. Madera or Gliricidia	125	2,000	6–8
Gossypium peruvianum. Peruvian Cotton	175	2,800	25
G. barbadense. Sea Island Cotton	280	4,480	35
Grevillea robusta. Grevillea	2,000	32,000	2–3
Hevea brasiliensis. Para Rubber	6–7	104	23
Howea Fosteriana. (Palm)	50	800	1
Kapok. See *Eriodendron.*			
Lagerstroemia Flos-Reginae. Queen's Flower	2,450	39,200	15
Leucaena glauca	620	10,000	15–18
Livistona rotundifolia. (Palm)	33	528	1
Lysidice rhodostegia	20	320	7
Madras Thorn. See *Pithecolobium dulce*			
Mangifera indica. "Jaffna" mango	1	16	1
Manihot Glaziovii. Ceara Rubber	44	704	3
Melia Azadirachta. Margosa	145	2,320	1
M. dubia. Lunu-midella, *S*	10	160	2–4
Mesua ferrea. Na, *S*; Ceylon Ironwood	26	416	2
Michelia Champaca. Sapu, *S*	150	2,400	4
Myristica fragrans. Nutmeg	2	32	1
Myroxylon toluiferum. Balsam-of-Tolu	15	240	1
Nerium Oleander. Oleander	3,000	48,000	—
Nephelium lappaceum. Rambutan, *S*	13	208	1
Nicotiana Tabacum. Tobacco	400,000	6,400,000	—
Oncosperma filamentosum. (Palm)	44	704	1
Oreodoxa regia. Royal Palm	80	1,280	1
Ormosia dasycarpa. Necklace Tree	16	256	1
Paddy. (Rice)	1,000	16,000	1
Panicum maximum. Guinea-grass	20,000	320,000	—
Parkinsonia aculeata	350	5,600	—
Pentadesma butyracea. Butter Tree	—	14	2–3
Parkia Roxburghii	32	512	8
Paspalum dilatatum. Paspalam grass	25,700	411,200	—
Passiflora edulis	1,000	1,600	184
Payena Leerii	16	256	1
Peltophorum ferrugineum	350	5,600	3
Pericopsis mooniana. Nedun, *S*	90	1,440	4
Phoenix zeylanica. (Palm)	75	1,200	1
Pithecolobium Saman. Rain Tree	120	1,920	10–12
P. dulce. Madras Thorn	250	4,000	8–10
Pterocarpus echinatus	356	5,696	1–2
Ptychosperma MacArthurii. (Palm)	60	960	1
Raphia Hookerii. (Palm)	1	16	1
Ravensara aromatica. Madagascar Clove	3–4	56	1
Sandoricum indicum. Santol	16	256	4–5
Sapium indicum	5	80	3
Sesbania aegyptiaca	2,000	3,200	10–15
Sideroxylon dulcificum	8	128	1
Spathodea campanulata	3,600	57,600	470
Styrax Benzoin. Benzoin Tree	3	48	3
Swietenia macrophylla. Large-leaved Mahogany	46	736	50
S. Mahagoni. Mahogany	120	1,920	45–55
Tamarindus indicus. Tamarind	25	400	4
Tea. See *Camellia.*			
Tectona grandis. Teak	24	384	2–3
Tephrosia candida. Boga-medeloa	1,120	17,920	8–12
Terminalia belerica. Bulu, *S*	8	28	1

NAME.	NUMBER TO AN OZ.	NUMBER TO A LB.	NUMBER IN EACH FRUIT.
Theobroma Cacao. Cocoa . .	12	192	35
Trachylobium verrucosum. Copal Tree .	40	640	1
Vateria acuminata. Hal, *S* . . .	—	2 (fruits)	1
Zea Mays. Indian Corn; Maize . .	80	1,280	400–600

SOME WEIGHTS AND MEASURES

CEYLON:

1 Manawa = $\frac{1}{2}$ nelli or 2 chundus.
4 Chundus = 1 measure.
1 Nelli = $\frac{1}{4}$ kuruni or laha.
1 Kuruni = $\frac{1}{5}$ bera (drum).
1 Bera = $\frac{1}{4}$ pela (bushel).
1 Pela = 1 bushel.
1 Amuna = 4 bushels.
1 Hunduwa = $\frac{1}{4}$ serua or measure.
32 Cut, or 28 loaded, measures = 1 bushel.
7 Séru = 1 karatuwa.
1 Karatuwa = $\frac{1}{4}$ bushel.
1 Thulama = $26\frac{1}{2}$ rathals (pounds).
1 Thukku = 56 rathals.
1 Parama = 20 thulams or 5 cwt.
1 Candy = 560 lb. or 5 cwt.

INDIA:

1 Tola = nearly $\frac{1}{2}$ oz. or R 1.
10 Tolas = 1 chittac.
1 Chittack = 4 oz.
8 Chittacks = 1 seer (about 2 lb.).
40 Seers = 1 maund (about 80 lb.).
1 Maund = 80 lb. (usually).
1 Lac = 100,000.
1 Crore = 1,000,000.
1 Bigha (Brit. India) = 40 × 40 yd. or $\frac{1}{3}$ acre.

MALAY:

1 Tahil = $\frac{1}{3}$ oz.
1 Kati or catty = $1\frac{1}{3}$ lb.
1 Picul (100 katties) = $133\frac{1}{3}$ lb.
1 Picul (Java) = 136 lb.
1 Koyan = $5,333\frac{1}{3}$ lb.

CEYLON (*Contd.*):

1 Candy (S. India) = 654 lb.
4 Candies = 1 ton.

WEIGHTS USED BY SINHALESE APOTHECARIES

1 Thala-eta (gingelly seed) = $\frac{1}{4}$ Amu-eta (*Paspalam* seed).
1 Amu-eta = $\frac{1}{3}$ Vee-eta (Paddy grain).
1 Vee-eta = $\frac{1}{2}$ Madatiya-eta (*Adenanthera pavonina*).
1 Madatiya-eta = $\frac{1}{20}$ kalanda.
1 Kalanda = $\frac{1}{12}$ palama.
1 Palama = $\frac{1}{8}$ rathala.
1 Rathala = 1 lb.

DUTCH:

1 Bau (bouw) = $1\frac{1}{4}$ acres.
1 Morgen = $2\frac{1}{8}$ acres.
1 Picul (Java) = 136 lb.

METRIC MEASURES, ETC.:

1 Millimetre = ·039 in.
25 Millimetres = 1 in. (about).
1 Centimetre = ·393 in.
30·5 Centimetres = 12 in.
1 Metre = 1 yd. 3 in.
1 Kilometre = 1,093 yd. 1 ft. 10 in.
1 Litre = $1\frac{3}{4}$ pints.
1 Kilogram = $2\frac{1}{2}$ lb. (nearly).
10 Kilograms = $2\frac{1}{4}$ lb. $0\frac{3}{4}$ oz.
$50\frac{3}{4}$ Kilograms = 1 cwt.
1 Hectare = nearly $2\frac{1}{2}$ acres.
1 Orlong = $1\frac{1}{32}$ acres.
1 Estrada = 150 Para trees (Brazil).
1 Palmo (Spanish) = $8\frac{2}{3}$ in.

ARABIC:

1 Rotl = 1 lb.
1 Oke = $2\frac{4}{5}$ lb.
1 Frasila = 35 lb.
1 Kantar = 100 lb.
1 Kile = 1 bushel.
1 Cantor = $4\frac{1}{2}$ cwts.
1 Feddan = 1 acre (slightly over).

ENGLISH MEASURES:

144 sq. in. = 1 sq. foot (ft.).
9 sq. ft. = 1 sq. yard (yd.).
$30\frac{1}{4}$ sq. yd. = 1 sq. pole, rod or perch.
40 sq. poles = 1 rood (ro.).
4 Roods = 1 acre (ac.).
640 Acres = 1 sq. mile.
43,560 sq. ft. = 1 acre.
4,840 sq. yd. = 1 acre.
70 sq. yd. = 1 acre (about).

12 in. = 1 foot.
3 ft. = 1 yard.
$5\frac{1}{2}$ yd. = 1 pole.
40 Pole = 1 furlong.
8 Furlong = 1 mile.
1,760 Yds. = 1 mile.
1 Hand = 4 in.
1 Span = 9 in.
1 Cubit = 18 in.
1 Fathom = 6 ft.
1 Knot = 1 nautical mile.
1 Cord of wood = 128 cu. ft.

CHAPTER XXXVIII

CALENDARS OF WORK FOR CEYLON

FOR COLOMBO DISTRICT

Average annual rainfall 88 in.; mean annual temperature 80° F.

(By C. DRIEBERG, late Superintendent of Low-country Products, and Secretary, Ceylon Agricultural Society, etc.)

January.—Average rainfall for the month 3·54 in. A fairly dry and cool month, during which little planting is done. A good season for vegetable produce, the result of the previous October–November planting. Yams and gourds plentiful. Annuals now well in bloom.

February.—Av. rainfall 2·08 in. A particularly dry month, during which no planting can be done. Seeds should be gathered and the soil worked up as crops go out. Where plants are growing, the surface should be stirred to prevent loss of moisture, beds being copiously watered and, when necessary, shaded.

March.—Av. rainfall 4·80 in. This is the month for weeding, digging and manuring the soil. Occasional showers may be expected. Nurseries, where necessary, should be started.

April.—Av. rainfall 11·03 in. General planting begins with this month, when the rainfall is usually plentiful. All varieties of vegetables and flowers may be planted with good prospects of favourable growing weather.

May.—Av. rainfall 12·04 in. South-west monsoon rains begin towards end of month, when planting may be continued. Fruits (such as mangoes, oranges, pineapples, mangosteens, etc.) begin to ripen. Many flowering trees in blossom.

June.—Av. rainfall 8·27 in. This is the best month of the south-west monsoon for planting generally. Weather fairly wet and hot. Many fruits in season.

July.—Av. rainfall 4·61 in. Fruits begin to go out of season by end of month; vegetables of April–May planting begin to come in.

August.—Av. rainfall 3·67 in. Slack month; weather hot and generally dry. Vegetables fairly plentiful. Fruits mostly out of season.

September.—Av. rainfall 5·03 in. Weather still dry. Most garden crops fall off. Seeds should be collected, and land prepared for planting again. Nurseries should be started.

October.—Av. rainfall 14·67 in. Second planting season begins with the North-east monsoon rains, which are now more or less general throughout the island. All kinds of crops may now be started, and fruit-, shade-trees, etc., planted.

November.—Av. rainfall 12·38 in. Planting may be continued. The best month for planting tomatoes and gourds in the low-country.

December.—Av. rainfall 6·03 in. General vegetable produce begins to come in, also annual flowers. Weather generally cool.

FOR JAFFNA AND N. PROVINCE

(By S. CHELLIAH, Agricultural Instructor, Jaffna.)

January.—Av. rainfall 2·15 in. Gather in crops of different kinds of yams (*Dioscorea*). Plant tobacco seedlings, also chillies and brinjals. Plantains are generally planted out this month, also the betel-creeper. The latter is the staple cultivation in the west of Jaffna.

February.—Av. rainfall 1·31 in. Gather in paddy crops. Sow dry grains, such as gingelly, kurakkan, peas, kollu, etc., soon after the main crops are harvested. Lift palmyra-kelengu (germinated seedlings), which are used as a vegetable. Water tobacco gardens and disbud the plants.

March.—Av. rainfall 0·93 in. Gather paddy crops and plough vacant paddy

fields. The season for extracting the juice (toddy) from Palmyra palms is from now to near the end of May. This forms an important occupation among the lower classes. Manioc (cassava) roots are now lifted and dried, to be used for food as required.

April.—Av. rainfall 2·35 in. Brinjals and chillies should now be planted. This is the time for planting out coconut plants. Gather dry grains sown in February. Gather and cure tobacco crops all over the North; harvesting and drying of chillies must be done now, also ploughing and manuring paddy fields and planting out Betel.

May.—Av. rainfall 2·01 in. This is the time for sowing the cereal "Tennai" (Italian millet), after the tobacco harvest is over, also for planting manioc (cassava) cuttings and different kinds of yams.

June.—Av. rainfall 0·79 in. Watering dry-grain crops in gardens will now be necessary, this being the dry season; it is also the principal fruit season in Jaffna. Plucking areca-nuts will be continued to the end of December. This is the time when land-owners make arrangements to have their garden lands cultivated with tobacco on lease.

July.—Av. rainfall 0·87 in. Reaping of dry grains sown in May will now proceed, also planting of betel, onions, etc. Palmyra fruit season begins, and continues to the end of September, during which time this forms a great relief to the poor as an article of food.

August.—Av. rainfall 1·44 in. Sowing of paddy in fields, also sowing and transplanting of kurakkan in gardens, may be done this month.

September.—Av. rainfall 2·80 in. Generally a slack month, and very little is done except the sowing of dry grains, as "varaku" and "kartu-samai" (*Setaria italica*) in Palmyra gardens. Palmyra nuts are sown for a kelengu crop.

October.—Av. rainfall 6·66 in. Weeding of paddy-fields, also transplanting and filling vacancies in these should now be seen to. Paddy seedlings are bought at Rs. 2 to Rs. 3 per 100 bundles. Some people sow paddy thickly for the purpose of selling thinned out seedlings at this period. Till and manure fields for tobacco; sow tobacco seed in prepared nursery beds. Fruit trees, areca-nuts, etc., may be planted now. The latter is commonly planted around wells.

November.—Av. rainfall 13·38 in. Generally a busy month for collecting green-manure for tobacco gardens, etc.

December.—Av. rainfall 11·34 in. Planting of tobacco all over the North should now commence. Onions are planted this month.

FOR UP-COUNTRY

(By the late J. K. Nock, Curator, Hakgala Gardens.)

January.—Weather wet, with foggy mornings; latter half of month often fine. Av. rainfall 8·22 in. on 16 days. Mean temp. 58° F. The finishing touches should now be given to the garden, drives, paths, etc., being attended to. All general planting should now be finished. Fork up the ground around young plants, applying some mulch of leaf-mould, well-rotted cattle manure or a fertiliser-dressing. Liquid manure may be given to pot-plants once a week, especially to flowering kinds. Phloxes, Verbenas, Petunias, etc., need pegging down as their growth advances. Remove superfluous buds from roses if fine blooms are required. Afford protection to tender plants against frost (as stated for December) during the nights of this and the next two months. Vegetable seeds of all kinds may be sown for keeping up a succession.

February.—Weather dry, with cold nights and mornings and hot bright days. Av. rainfall 3·05 in. on 9 days. Mean temp. 60° F. Much watering is usually necessary. Liquid manure may with benefit be applied to bed and border plants. Supply vacancies where necessary. Weed and lightly fork over beds and borders. Stake plants needing supports, *e.g.* Carnations, Antirrhinums, etc. Collect cattle-dung for potting work, and cut and stack turf-clods, the latter being placed grass-side down, with manure between each layer. Pot out flowering plants. Place clean straw under Strawberries before they begin to ripen. Vegetable seeds of all kinds may be sown.

March.—Weather dry. Av. rainfall 4·54 in. on 9 days. Mean temp. 62° F. The brightest month in up-country flower-gardens. Routine work as last month—collect seeds as they ripen. If a lawn is to be made, prepare the ground early in the month for sowing in April, or for turfing in May or later.

April.—Weather showery. Av. rainfall 7·62 in. on 16 days. Mean temp. 64° F.

Sow seeds collected last month. Cut away dead stems, leaves, etc., from annuals, and pull out unsightly plants that have finished flowering; keep drains and culverts clear in case of heavy plumps of rain. This is the best month for sowing lawn-grass seed. Owing to the approaching S.W. monsoon rains, it is not advisable to put down such vegetables as potatoes, peas, beans, and onions, until at least the end of July.

May.—Weather showery with strong wind, after the arrival of the S.W. monsoon about end of month. Av. rainfall 6·90 in. on 15 days. Mean temp. 65° F. Stake tall plants in exposed positions. Continue to collect and sow seeds. Annuals that have finished flowering should be pulled up, and the ground turned over and prepared for planting with fresh seedlings. Advantage should be taken of the wet weather for planting pockets in banks, rockeries, etc. Repair turf of lawns where necessary. Except potatoes, onions, and peas, a few vegetables may be sown, although they are liable to be damaged by strong gales and rain unless protected. These remarks apply also to June and July.

June.—Weather generally wet with strong S.W. gales. Av. rainfall 8·13 in. on 19 days. Mean temp. 62° F. Plant up vacant corners and banks. Put in cuttings of all kinds, especially such as Verbenas and Petunias, which have finished flowering. Stack manure; where necessary lay down turf and repair verges. Prune shrubs and trees. Order foreign seeds so as to arrive by the end of August for the next "flowering season," viz. February–May.

July.—Weather moderately wet, but still squally. Average rainfall 6·02 in. on 19 days. Mean temp. 62° F. The most difficult month in which to keep a garden tidy, owing to the prevailing strong winds. Clear up debris and place collected leaves in pits to form leaf-mould. Continue planting banks, rockeries, etc. Divide and replant violets in open sheds. Prune fruit-trees generally. Prick out seedlings and plant out when large enough. Plant-shed roofs should be made rain-proof. Most pot-plants will now require repotting or top-dressing. When the weather is too wet for out-door work, all pots, boxes, etc., should be washed and prepared for later use. Prepare soil, store away leaf-mould, cattle-dung, etc. Amaryllids and Liliaceous plants generally blossom well this month.

August.—Weather fairly dry and pleasant, though often windy. Av. rainfall 4·43 in. on 17 days. Mean temp. 62° F. Foreign seeds ordered in June should now have arrived, but must not be opened until the ground is ready for sowing them. Sow such seeds as Begonias, Campanulas, Carnations, Cyclamens, Gloxinias, Golden Feather, Petunias, Salpiglossis, Stocks, Sweet-Peas, etc., sowing small quantities at intervals, keeping the balance in air-tight tins or bottles until required. Sweet-peas and Nasturtiums may be sown where intended to remain, the plants being afterwards slightly cut back to retard flowering if desired. Cuttings of Verbenas, Petunias, etc., should be inserted early in the month, so as to be ready for December planting. Supply vacancies in beds and borders. Prune shrubs and trees where necessary. Top-dress or repot orchids. Vegetables of all kinds, except potatoes, may be planted out early in the month.

September.—Weather mild and pleasant. Av. rainfall 5·78 in. on 18 days. Mean temp. 62° F. Mulch annuals which have been planted out in June and July, especially those in un-manured beds. Continue supplying vacancies where they occur. Prick out seedlings, as they become large enough to handle, into boxes or beds under cover. Where the sowings in sheds have been too thick the seedlings must be thinned out. More sowings should now be made of Pansies, Phlox, Dianthus, Nemesia, etc. Further sowings of Sweet-peas should be made towards end of month. Dahlias should be taken up and stored in a dry place to rest for about 6 weeks before re-planting in November. Sow vegetables of all kinds. Potatoes if planted out now may suffer from the heavy N.E. rains of the next 2 or 3 months.

October.—Weather usually wet in the afternoons with the advent of the N.E. monsoon. Av. rainfall 11·95 in. on 23 days. Mean temp. 62° F. The most suitable month for general planting. Plant up pockets in banks, attend to repotting, prune back Geraniums, Pelargoniums, etc.; water these sparingly until new growth has commenced. Insert cuttings of all kinds. Sow succession of Sweet-peas towards the end of month. Pot Cinerarias, tuberous-rooted Begonias, Gloxinias, etc., increasing the size of pots each time of potting. Where annuals are wanted in bloom during the hill season (middle of January to end of May), these should be sown in succession from end of October to end of January. Roses here take two months to come into bloom from the time of pruning, so that the latter operation should be carried out according to one's requirements. Vegetables as last month.

November.—Weather wet and dull, often with heavy plumps of rain. Av. rain-

fall 11·29 in. on 21 days. Mean temp. 60° F. Watch for pests, especially black-grub (*q.v.*); early morning is the best time to catch these. Slugs and insect pests are liable to be troublesome this month; sprinkle unslaked lime round affected plants. Green caterpillars are liable to attack Cinerarias and Stocks. The general planting up of beds and borders should be commenced as soon as the seedlings are large enough. Plant out roses, giving them a light pruning 3 or 4 weeks later. Sow vegetables of all kinds from now onwards.

December.—Weather often excessively wet and misty. Av. rainfall 12·84 in. on 21 days. Mean temp. 58° F. Weather conditions generally against plant-growth, the days being sunless and misty, with almost continual drizzle and heavy rain at frequent intervals. "Damping off" and pests are prevalent. Constant attention must be directed to the destruction of pests and the supply of vacancies. Weeds are apt to become troublesome this month. The surface soil should be forked over frequently, as the continuous rain tends to cake it. Attend to potting of plants generally. Replant strawberries. Cadjans or some similar material should be obtained for covering all plants that are susceptible to frost, which is now liable to occur at night at the higher elevations. Sow vegetables of all kinds.

FOR THE MOIST LOW-COUNTRY AND MEDIUM ELEVATIONS

(By the Author.)

The following general remarks may need modification according to weather, local circumstances and elevation. For average rainfall in principal towns in Ceylon, see p. 3.

January.—Weather generally dry, with strong North-east wind. Planting operations in the open should cease. Collect fallen leaves on lawns, etc., and place in a deep trench to form leaf-mould. Order plants of roses, etc., from abroad, so as to arrive in April or May. Cloves are now in season. These should be collected before the buds open, and spread out on mats to dry in the sun. Tamarinds, pine-apples, and Cochin-goraka are fruits in season. *Congea tomentosa* still in flower.

February.—Usually the driest month of the year, with very dry, parching N.E. winds. The surface soil should be stirred up frequently so as to check the evaporation of moisture. Much watering will be necessary for pot-plants, shrubberies, beds and borders. Overhaul pot-plants and seed-boxes, and order new stock if required. Syringe pot-plants frequently, at least twice a day in hot, dry weather. Repair drives and paths; mulch surface-soil among crops of all kinds. Where practicable, all plants with delicate leaves should be afforded partial shade. Do not water bulbous plants which may now be in a resting state. Flower-seeds may be ordered from abroad. Pineapple, star-apple, and lovi-lovi in season. *Bombax, Jacaranda, Bignonia venusta, Gliricidia, Tabebuia, Petrea*, etc., in flower.

March.—Weather dry and hot, and most trees, crops and tender plants suffer from drought. Towards end of month, plant out yams, sweet-potatoes, and similar root-crops. Watering, shading and mulching should be the order of the day. Loosen the surface soil frequently by light forking where artificial watering is carried on. Syringe pot-plants morning and evening with clean water. Re-potting of plants should now be carried out. Fruits in season: Pineapple, pomegranate, cannon-ball tree, velvet-apple, Madagascar clove, etc. In flower: *Jacaranda, Gliricidia, Spathodea, Bignonia venusta, Saraca declinata, Amherstia, Tabebuia* spp., etc.

April.—Weather hot and muggy, with frequent thunderstorms. Keep drains, water-channels and culverts clear of leaves and rubbish, and provide means of escape for excessive rain-water. Plant out yams and native vegetables of all sorts. Overhaul banana clumps, cutting out barren stems and dried leaves, and burying the latter round the plants. Oranges, jak-fruit, star-apple and bullock-heart in season. *Cassia grandis, Schizolobium, Bignonia unguis, Jacaranda, Poinciana* (Flamboyante), *Gliricidia, Sterculia colorata, Hippeastrums, Zephyranthes*, etc., in flower.

May.—The hottest month of the year. Prepare ground for all kinds of vegetables. Procure sticks for supporting beans, peas, etc. Collect potting soil and store away as much manure and leaf-mould as possible before the south-west monsoon rains begin. Re-planting of flower beds and borders should be put in hand, the ground being first well trenched and manured. Fertilise Vanilla flowers now in blossom. Mangoes, cashew-nut, pineapples, papaws, etc., in season. *Dendrobium MacArthiae* ("Wesak-mal"), *Michelia Champaca* (Sapu), *Lagerstroemia Flos-Reginae, Cananga* (Ilang-ilang), *Cassia nodosa, Poinciana, Petrea*, etc., in flower.

June.—If not already arrived, the South-west monsoon is due early in the month. As soon as rainy weather begins sow English vegetables and flower seeds of all kinds. Mow lawns and dig out white-ants' nests. Dig up, manure, and re-plant borders, flower-beds, etc. Renovate rockeries and ferneries, applying fresh soil if necessary. Overhaul foliage plants, etc., in pots, and re-pot those requiring it. Principal fruits in season: Mango, mangosteen, pineapples, oranges, kamaranga, jambu, bread-fruit, cashew-nut, Java-almond, nam-nam, sandoricum, soursop. Flowers in season: *Lagerstroemia, Cassia nodosa, Peltophorum, Kleinhovia*, etc.

July.—Weather usually cool, with moderate rainfall. Plant out fruit, shade and other useful or showy trees, also general ornamental plants. Attend to propagating work of all kind. Keep down weeds. Earth up root-crops, and stake peas, beans, etc. Mow and roll lawns. Budding and grafting work may now be undertaken. Prune roses which have finished flowering. Foreign seeds may be ordered for sowing in September. Fruits in season: Mangosteen, pineapples, mamme-apple, durian, bread-fruit, Cochin-goraka. Flowers in season: *Pometia eximia, Porana, Fagraea, Ipomœa, Petrea*, etc.

August.—Weather moderately dry. Gardens in the low country should be at their best during this month. Attend to general weeding of vegetable and flower gardens, also mowing of lawns. Fork up surface soil between crops, also of beds and borders generally. Attend to the lopping of shade trees which have exceeded their proper limits and have finished flowering. Principal fruits in season: Avocado-pear, mangosteen, durian, sapodilla, guava, oranges, goraka, etc. In flower: *Cassia Fistula, Solanum macranthum, Spathodea*, Teak, etc. Hevea seed in season.

September.—Usually a fairly dry month. Renovate flower-beds and borders, affording mulch to the surface; tie up tender stems or heavy flowers to neat stakes. Fresh sowing of English vegetables and annuals should now be made. Repair drives and paths. Fruits in season: Oranges, papaws, pineapples, Ceylon-gooseberry, lovi-lovi, soursop, etc. In flower: *Cassia multijuga, Spathodea, Gloxinia maculata*, etc.

October.—Usually the wettest month of the year and generally the best season for planting. Attend to the planting of shade, fruit, wind-belt trees, etc.; also to transplanting work in general. Prune shrubberies, fruit trees, etc., and attend to propagating work of all kinds, also to the re-potting of ornamental plants. Principal fruits in season: Oranges, pineapples, voa-vanga, soursop, custard-apple, bullock's-heart, papaw, and nutmeg (second crop). Flowers: *Vanda spathulata, Spathodea, Congea*, etc.

November.—Weather usually wet and fairly cool. All general planting work should be completed this month. Pruning or thinning out of shrubs, trees, etc., should now be attended to. Sow peas, beans, beet and other vegetables. Yams are now ripe and should be lifted and stored in sand, in a cool shed. Attend to pollinating Vanilla flowers, now in second season. Prune roses that have finished flowering. See to drainage and soil requirements of pot plants. Principal fruits in season: Papaws, oranges, bullock's-heart, pineapple, soursop, etc. Flowers: *Aristolochia* (several spp.) *Palicourea, Acalypha sanderiana, Petrea*, etc.

December.—A fairly wet month, often with strong winds. Support all tender plants and young trees in exposed situations, fixing stout stakes to the latter. Afford shade to such plants as require it, in view of the approaching dry season. Collect seeds of flowering plants, annuals, etc., and store when dry in stoppered jars. Collect fallen leaves and place in a pit or trench to form leaf-mould. Several trees drop their leaves for a short period during this and next month. Principal fruits in season: Custard-apple, wood-apple, *Dillenia indica*, and *Elaeocarpus edulis*. Flowers: *Wagatea spicata, Naravelia zeylanica, Pachira insignis, Wormia Burbidgei, Mussaenda, Petrea, Congea*, etc.

GLOSSARY

[*See also* Index]

Acuminate, tapering to a point, as a leaf.
Adventitious, abnormal, as buds or shoots which arise out of an unusual position.
Air-plants, not attached to the ground; epiphytic plants, *e.g.* Bromeliads, Orchids, etc.
Ala, Sinhalese for yam, bulb, or tuber.
Albumen, the endosperm of a seed; albuminoids, see *Proteids.*
Alkaloids, compounds of alkaline reaction obtained from certain species of plants, the name often indicating the genera, e.g. *caffeine* from coffee, *theine* from tea, *theobromine* from cocoa, *nicotin* from Nicotiana, *strychnine* from Strychnos, *strophanthine* from Strophanthus.
Angiosperms, one of the two great divisions of phanerogams (flowering or seed-bearing plants), which possess true flowers and ovules enclosed in a carpel, as distinct from gymnosperms, which have no true flowers and in which the ovules are not enclosed in carpels.
Annual, a plant which completes its life-cycle, including flowering and fruiting, within one year.
Antiquorum, of the ancients.
Aquatic, specially adapted for growing in water; a water-plant.
Arborescent, becoming tree-like, nearly the size of a tree.
Arboretum, a place assigned to the culture of trees, generally in systematic order.
Aril, an expansion or growth from the placenta enveloping the seed, *e.g.* mace of Nutmeg, also in Akee, etc.
Arrack or raki, a spirit distilled from the sap of certain palms, as Coconut, Date, Palmyra and others; also from rice in India, Japan, etc.
Assimilation, the formation of organic substance from carbon dioxide and water by green plants in sunlight; the conversion of crude food into plant substance. See pp. 10–15.
Asweddumize, to clear ground and bank up for irrigation, as in paddy cultivation.
Atmospheric pressure : 30 lb. to square inch at sea-level; 1 lb. less for about every 900 ft. in altitude.
Attaps, plaited leaves of palms, especially *Nipa*, used for thatching, etc., in Malaya.
Awn, a bristle-like appendage on the glumes of grasses, corn, etc.
Axil, the angle formed between the axis and any organ which arises from it, as a leaf or shoot from the stem or branch.
Balati, foreign (India), hence "Blighty." See also *Rata* (Sinh.).
Balm, a fragrant exudation of certain plants used in ointments for healing or for soothing pain.
Balsam, a semi-fluid, fragrant gum obtained by exudation from certain plants, valued in medicine, etc. See also kino, copal, dammar, elemi, etc.
Barbecue, a drying ground for gathered crops, as for coffee, cocoa, copra, etc., close to the store or factory.
Bast, a fibrous tissue used for tying purposes; especially the fibrous inner bark (phloem) of certain plants or trees.
Bech-de-mer, a sea slug (*Holothuria*), eaten as a delicacy by some people, chiefly Chinese. Large quantities have until recently been exported annually from Ceylon to China, being valued at about 50*s.* per cwt.
Biennial, a plant which requires two years to complete its life-cycle, flowering and fruiting only in the second year.
Bipinnate, twice pinnate, as when both primary and secondary division of a leaf are pinnate. See *Pinnate.*

Blight, an epidemic, generally of minute fungi (moulds) or of insects.
Bloom, the white waxy covering on certain fruits, *e.g.* grapes; also blossom or inflorescence.
Bole, the trunk or base of a tree.
Boll, fruit capsule or pericarp, as of the cotton plant.
Bonchi, Sinhalese for young beans, from boontje (Dutch).
Boutique (Portuguese), a native shop or kaddie; in India, a bazaar.
Bract, a modified leaf, intermediate between the calyx and normal leaves, sometimes brightly coloured, *e.g.* Poinsettia.
Budding, a mode of propagation in which a bud from one plant (scion) is inserted under the young bark of another (stock). See p. 45.
Bulb, a modified stem surrounded at base with fleshy scales (modified leaves) folded round the central bud, forming (*a*) a scaly bulb, as in Lilium, or (*b*) a tunicated bulb, as in onion. See also *Corm.*
Bullate, a leaf-surface in which the parts between the veins (which are sunk) are raised like blisters.
Bund, a raised bank or dam surrounding a reservoir, tank, or irrigated field.
Burr, a rough prickly covering of fruits or seeds.
Cabook, a Ceylon word, of Portuguese origin, for laterite, or moorum of India; a red ferruginous clay or marl which hardens on exposure. Common in low-country and often used for building, etc. See p. 9.
Cadjan, a plaited coconut-leaf split from the midrib. See p. 485.
Caducous, falling early, as leaves or petals.
Caffeine, the active principle of coffee (similar to *theine* of tea); also found in kola-nut, etc. See *Alkaloids.*
Calcareous, lime-stone or chalky soil.
Callus, an outgrowth of tissue formed to cover a wound or cut, as at the base of a cutting when planted.
Calorie, unit of heat; the amount of heat which raises 1 lb. of water 1° F. The average adult person doing ordinary work requires a diet of 3,000 calories per day.
Calyx, composed of sepals; the outermost circle or envelope of a typical flower.
Cambium, a thin layer of formative tissue between the wood and bast, adding elements to both, viz. wood (xylem) on the inner, and bast (phloem) on the outer side. See p. 10.
Canker, a fungus disease generally indicated by malformed bark with swollen cushion-like margin and depressed centre. See *Fungi.*
Capsule, a dry dehiscent fruit, naturally bursting open when ripe.
Carpels, component sections of a fruit or ovary; the pod of a bean consists of a single carpel.
Caterpillar, the larva of a moth or butterfly (*Lepidoptera*). See *Grubs, Larva, etc.*
Centreing, to cut out the centre of a bush or tree, as in Tea or Coffee, converting a tree form to a spreading bush.
Cereal, any Gramineae (grass family) whose seed serve as food; Rice, Maize, etc.
Cespitose, tufted, as grasses which grow in tufts.
Chatty, an earthenware vessel.
Cheddy, scrub; secondary vegetation after a clearing of jungle.
Chekku, a crude oil-mill worked by bullocks, the oil being extracted by pressure.
Chena (Sinh.); "ladang" (Malay); "jhuming" (India). See p. 33.
Chlorophyll, the green colouring-matter of plants, formed under the influence of sun-light. See pp. 12–14.
Chlorosis or pallor, loss of colour; blanching of normally green tissues, or the turning green of petals, as in a green rose. See *Proliferation.*
Chunam (Sinh. and Tam.), lime, either slaked or unslaked.
Cob, the fruit spike of maize.
Coir, the fibre from the coconut husk, largely used for mats, brushes, ropes, etc.
Cladode, a branch of a single internode simulating a leaf, e.g. *Asparagus.* See *Phyllode* and *Phylloclade.*
Collar, the ground-line or neck of a plant; the imaginary boundary between the above and underground portion of a plant.
Compound, the garden or ground round a bungalow.
Concinnus, neat, elegant.
Cone, fruit of a pine-tree, with scales.
Copal, a hard resinous exudation found at the base of certain trees in the tropics.

Coppicing, the periodical cutting-back of trees, which become replaced naturally by undergrowth from suckers, etc., as in forestry. Some trees are especially adapted to coppicing.
Cordate, heart-shaped, as leaves.
Corm, a bulb-like fleshy stem; a " solid " bulb without scales. See *Bulb*.
Corn, cereals generally; in the United States, maize; in Scotland, oats.
Corolla, the inner, usually coloured, envelope of modified leaves (petals) of a flower.
Cortex, the inner or live portion of bark, or tissue between the cambium and periderm; the outer scaly or corky portion being the true bark. See p. 10.
Coumarin, the odour of new-mown hay. See *Dipteryx*.
Creeping, growing along on the soil surface or on walls and rooting at the nodes, as distinct from climbers which ascend by means of tendrils, spines, twining stems, and other means.
Cross, the offspring resulting from the cross-fertilisation of two varieties of one species; **cross-breeding**, the inter-breeding of varieties or individuals, a hybrid being a cross between two species.
Culm, the hollow stem or " straw " of grasses and grain crops.
Currants (corruption of Corinth, in Greece), the sun-dried berries of a seedless variety of grape, largely cultivated in Greece, Smyrna, etc.
Cryptogams, the division of spore-bearing plants, comprising ferns, fungi, etc., which are destitute of stamens, pistils and true seeds, but often reproduced as a result of a sexual act, as in alternation of generations. See *Prothallus*.
Dammar. A resinous substance obtained from certain trees, as Dipterocarps, Coniferae, etc.
Deciduous, leaf-losing; periodical falling of leaves, as at beginning of dry season in tropics, or of cold season in cool countries; uncommon in tropics.
Dicotyledons, one of the two main divisions into which flowering plants (Angiosperms) are classed (the other being Monocotyledons), characterised by the possession of two or more cotyledons or seed-leaves. See *Seeds*, p. 12.
Dioecious, the male (staminate) flowers on one plant, and female (pistillate) on another, as usually in Carica and many tropical trees and palms. See p. 11.
Discolor, different colours, as when the two surfaces of a leaf are unlike in colour.
Dormant, resting, not in active growth; usually deciduous. See *Resting period*.
Duramen, heartwood of an exogenous (dicotyledonous) stem which has become hardened and often coloured by deposits of tannic acid, etc., as distinct from sapwood.
Ear, spike of grain, as in corn or paddy, especially when first appearing.
Ecology, the study of plant-life in relation to environment.
Economic botany, the study of the uses of plants or their products.
Economic plants, applied to species which are of use to man, directly or indirectly, as distinct from plants which are merely ornamental.
Embryo, the young plant contained in the seed.
Endemic, confined to a given region, as an island or country.
Endocarp, inner layer of a pericarp of drupe fruit, *e.g.* hard shell of the coconut.
Endogens, applied to monocotyledonous plants, the term exogens being applied to Dicotyledons and Coniferae.
Endosperm or albumen, the nutrient tissue around the embryo in seed of Angiosperms.
Epicarp, external layer of a pericarp, *e.g.* the husk of coconut.
Epiphyte, a plant which grows upon another (not parasitically) for support, generally not attached to the ground; an " air plant "; e.g. *Orchids*, *Bromeliads*, etc.
Esculentus, edible; used in botanical names.
Evanescent, lasting only a short time, as flowers; fugacious, caducous.
Eximia, excellent, distinguished.
Exogens, applied to plants which increase in growth of stem by addition of wood on the outer side, beneath the bark, as distinct from endogens; dicotyledons.
Exudation, a discharge of resinous or gummy substance from plants, as gums, resins, rubber, etc., spontaneously or through wounds or incisions in the bark.
Fairy-rings, patches of light or deep green in pastures caused by a fungus which, dying away from the centre, spread in circles. See *Lawns*.
Fan-palm, a palm whose leaves are not pinnate or divided to the midrib or rhachis, *e.g.* Licuala, Livistona, Corypha, etc.
Farinaceous, of the nature of starch or containing farina; mealy, floury.
Fasciation, a bundle or fascicle caused by abnormal growth due to a form of disease or galls. See " *Witches' Broom*."

Fellaheen, peasants (Arabic); goiya, *S*; ryot (Indian).
Fertilisation, the action of pollen upon the pistil through the stigma. See *Pollination*.
——, **cross-**, fecundation by pollen from another individual of close affinity, often occurring naturally in nature owing to special adaptations of flowers.
——, **self-**, the action of pollen upon the pistil of its own flower or on that of others of the same plant; close breeding.
Filament, the stalk of a stamen, bearing one or more anthers.
Flagging or wilting, hanging loosely, without normal rigidity, owing to insufficient water in the tissues, or to excessive watering causing an unhealthy condition of the roots.
Flush, the periodical production of copious young shoots, as of Tea in bearing; a sudden rise of sap after a dormant period.
Flowering-plants, phanerogams or seed-bearing plants, as distinct from cryptogams (comprising ferns, fungi, etc.) which produce spores but no seeds.
Foetid, smelling strongly and disagreeably.
Formosus, beautiful, handsome.
Fossil, the remains of a plant (or animal) changed into stone; a fossilised plant.
Friar's Balsam, a medicinal preparation consisting mainly of *Styrax Benzoin* (*q.v.*).
Fruit, a fertilised and developed ovary; an edible enlarged ovary with a succulent pericarp.
Fugacious, fleeting, soon perishing, as flowers; evanescent, caducous.
Gecko, a small creamy-white nocturnal lizard which inhabits bungalows.
Genus, a group of closely allied species. See *Species*.
Gluten, a viscous proteid substance occurring in grain, as distinct from starch.
Go-down, a store-room or out-house.
Goiya, a Sinhalese farmer or cultivator; ryot (Indian); fellaheen (Arabic).
Gootee. See *Marcottage*, also p. 41.
Gourmandisers, strong shoots arising from the stem, as in Cocoa, Coffee, etc.
Grandiflorus, comparatively large-flowered; used in botanical names.
Gregarious, applied to plants of one kind which occur naturally in close proximity. Gregarious flowering is applied to plants which flower simultaneously after a lapse of years, as species of Bamboos, Strobilanthes, etc.
Grubs, the larvae of beetles and weevils (Coleoptera). See *Insect Pests*.
Gum-resin, a semi-solid or viscid sub-resinous exudation from certain plants.
Gymnosperms, a division of seed-bearing plants, including Fir-trees, Cypress, Cycads, etc. See *Angiosperms*.
Habitat, the kind of locality in which a plant naturally grows, as forest, mountain, etc.; the geographic distribution or native home of a plant.
Halophytes, plants adapted to sea-shores or salt-laden land.
Hastate, with two pointed lobes projecting at base.
Haulms, stems of herbaceous plants, as distinct from culms of grasses, etc.
Heartwood, the inner hard portion of wood of a dicotyledonous plant, no longer useful for conducting sap, generally distinguished from sapwood by its darker colour. See *Duramen*.
Herbaceous garden, a section of a botanic garden devoted to herbaceous or herbaceous-perennial plants, planted in systematic order.
—— **plants**, those with perennial rootstock and succulent stems which die down periodically; in cold countries they die down in winter to the rootstock.
Herbarium, a collection of dried specimens of plants, mounted on sheets of paper and systematically arranged and named.
Hermaphrodite flowers, both pistil and stamens in one flower. See p. 11.
Hilum, the scar left on seed where formerly attached to the placenta or funicle.
Hortensis (Hort.), pertaining to gardens, or only found there.
Humus, decomposing organic matter in the soil. See p. 6.
Hybridisation, the crossing or fusion of two different species by the action of the pollen of one on the pistil of the other, the resulting plant being a hybrid. See p. 47, also *Cross-fertilisation*.
Incompletae, applied to a group of plants whose flowers are either without a corolla or calyx (incomplete), as in Urticaceae, Euphorbiaceae, etc.
Indehiscent fruit, not opening by valves or along regular lines, *e.g.* Coconut, Areca-nut, etc. See *Dehiscent*.
Inflorescence, a collective term for flowers when several are borne on one main axis, as panicle, raceme, umbel, etc.
In situ, sowing at stake, or where a plant is intended to remain after germinating.

Internode, the space between two nodes or joints of a shoot.
Jaggery, palm sugar, hakuru (Sinh.), karupoti (Tamil), gur (India) (*q.v.*).
Jat, a variety or kind (India); jathi, Sinhalese.
Kaddie or **kaddai**, a boutique; a native shop; bazaar.
Kai, ripe fruit; often used in Tamil names; "pallam" denotes unripe fruit.
Karupoti, jaggery (*q.v.*).
Kava, a national drink in Fiji (*q.v.*).
Kelengu (Tamil), yam, bulb, or tuber.
Kernel, seed or "stone" within a shell, or husk of 1-seeded fruit.
Kharif, an autumn crop in India, sown just before the south-west monsoon and harvested in August or September.
Kurumba (Sinh.), an immature coconut containing a refreshing, clear liquid.
Lamellae, the gills of a mushroom or toadstool (*q.v.*).
Lamina, the blade of a leaf.
Larva, an insect in the stage between the egg and pupa or chrysalis. See *Caterpillar*.
Laterite soil, a clayey acid earth, characterised by the presence of iron oxides, giving it a distinct reddish colour; common in tropics. See *Cabook*.
Latex, milky fluid of plants, as of Hevea, Ficus, Euphorbia, etc. See *Rubber*.
Layering, the rooting, as by artificial means, of a branch while still attached to the parent plant. See p. 40.
Leaf, composed of blade (lamina) and stalk (petiole).
Legume, a pod; a single-carpel fruit, as in peas and beans, belonging to the family of legumes (Leguminosae).
Lianes or lianas, great woody climbers found in wet tropics. See p. 126.
Lichen, a cryptogamic compound-plant, without stem or leaves, formed by union of an alga and fungus, growing on rocks, trees, etc., or in water.
Lilies, commonly applied to plants of Amaryllideae, Liliaceae, Nymphaeaceae, etc.; strictly speaking, Liliums only.
Lines, houses of native-labour force, usually built in double rows with a single central wall, along either side being single rooms facing opposite directions.
Lutescens, yellowish, becoming yellow.
Maggots, the larvae of flies (*Diptera*). See *Grubs*, *Caterpillars*, etc.
Maguey, a general South American term for Agave.
Maha-crop (Ceylon), the principal rice crop of N.E. monsoon season, as distinct from "yala" or smaller crop, the former being sown in September or October and harvested in February or March. See under *Rice*.
Malacophilous, plants favoured by snails. See *Snail Plants*.
Maram (Tamil), a tree; used as an affix in Tamil names.
Marcottage, a method of propagation by a form of layering. See *Goottee*, p. 41.
Medullary rays, plates of open cellular tissue radiating from the pith (centre) to the cortex in trees; the "silver grain."
Melanoxylon, black-wooded, as species of Acacia, Dalbergia, Diospyros, etc.
Mesocarp, the middle part of the wall or husk of a fruit, between endocarp and epicarp.
Mesophyll, the inner tissue or parenchyma of a leaf, under the epidermis.
Micropyle, a small opening, often dark in colour (near hilum), in ovule, through which the radicle emerges in germination (*q.v.*).
Monocotyledons. See *Dicotyledons*. Plants with one cotyledon or seed-leaf, the leaves being usually parallel-veined, not net-veined as in dicotyledons.
Monoecious, male and female organs in separate flowers on same plant, as in many gourds (Cucurbitaceae). See also *Dioecious*.
Mother-of-clove, the ripe fruit (seed) of the Clove tree.
Mother-plant, a seed-bearer; a plant from which vegetative portions have been selected for propagation.
Mycelium. See *Spawn*, also *Fungus Diseases*.
Mycorhiza, a fungus whose hyphae take the place of root-hairs on its host-plant, growing symbiotically with the latter, as in orchids (*q.v.*).
Myrmecophilous, a plant having hollow tubers, internodes, petioles, spines, or other adaptations which harbour ants for mutual benefit (*q.v.*).
Naturalised, a plant of foreign origin but acclimatised and reproducing itself as though indigenous.
Nectar, a sweet fluid excreted from various parts of plants; in the flower it is called honey. **Nectary**, the organ in which nectar is secreted.
Nematodes, minute thread-like grubs which are injurious to plants (*q.v.*).
Nidus, literally a nest; a favourable spot for a seed or spore for germination.

Nitrification, the building up by a nitric ferment of nitrites and nitrates, the reverse process being de-nitrification.
Node or **joint**, the part (often swollen) of a stem from which normally arises a leaf or a whorl of leaves.
Nodules, small knobs or swellings commonly found on the rootlets of leguminous plants and formed by bacteria.
Nucleus, the central part of an ovule in which the embryo plant is generated; an essential part of a plant cell.
Nut, a hard and indehiscent one-seeded fruit; often vaguely applied to fruit in a pulpy covering, as palm fruits, etc.
Officinal, applied to medicinal plants, especially those used by herbalists.
Offset, a lateral shoot or division used for propagation.
Ola, immature leaves of "talipot" and "palmyra" palms, bleached and used for writing on with iron stylus. See *Talipot*.
Ovary, that part of the pistil which contains an ovule or ovules, which on being fertilised become the seed or seeds.
Pachwai, an intoxicating beer made from rice in India. See *Arrack*.
Pallam. See *Kai*.
Pallor. See *Chlorosis*.
Palmate, like the palm or hand. Leaves arranged like a fan.
Parasite (total), a plant which grows and lives on another, deriving nutriment from its host, as fungi and *Cuscuta* (*q.v.*).
——, **Semi-**, a plant living upon another, but bearing green leaves and therefore not entirely dependent on it, e.g. *Loranthus*, *Mistletoe*, *Viscum*, etc.
Patana, a grassy expanse almost or quite devoid of trees, mostly at high or medium elevations.
Pea-berry, a coffee berry with only one seed.
Pedicel, the stalk bearing a single flower, often absent (sessile).
Peduncle, the main stalk of a group of flowers or inflorescence.
Peltate leaf, e.g. *Colocasia*, *Macaranga*, *Nelumbium*, *Tropaeolum*, etc. (*q.v.*).
Perennial, a plant which lives for more than two years, as distinct from annuals (one year) and biennials (two years).
Perianth, the calyx or corolla, specially when both are similar. See p. 11.
Petaloid, petal-like; sepals or stamens assuming the appearance of petals. See p. 471.
Petiole, the stalk of a leaf, sometimes absent, when the leaf is sessile.
Phanerogams or **flowering plants**, the higher orders of plants in which flowers with stamens and pistil are distinctly developed. See *Angiosperms*.
Phylloclade, a flattened stem or branch assuming the functions of leaves, e.g. *Muehlenbeckia*, *Semele*, *Phyllanthus*. See *Cladode*.
Phyllode, a flattened green petiole resembling a leaf, e.g. *Acacia melanoxylon* and other species of Acacia in seedling stage.
Phloem, the outer part of a vascular bundle, conducting plant-food in solution.
Pileus, the umbrella-like expansion of a mushroom or toadstool.
Pillu, Tamil for grass or weeds.
Pinnate, applied to leaves with divisions reaching to the midrib, like a feather; if twice divided, it is bipinnate, *e.g.* many species of *Acacia* and *Cassia*.
Pinnatifid, pinnately cleft; a leaf not divided to the midrib.
Pip, small seeds, as of apple, orange, etc.
Pistil, the female organ of a flower, consisting of ovary, style and stigma when complete. See *Incompletae*.
Pita, a South American term for Bromeliad fibre (*q.v.*).
Pitch, a resinous, tar-like exudation from the Spruce tree.
Pitcher-plant, *Nepenthes*, whose leaves end in a distinct pitcher with a lid; also *Sarracenia*, in which the whole leaf is formed into a pitcher. See *Fly-catchers*.
Pith, the centre of an exogenous stem; soft, cellular, spongy wood.
Plumule, the primary stem-bud of an embryo as it develops from the seed in germination. See p. 12.
Pollarding, lopping or removing the crown, as of roadside trees, which afterwards send out new shoots or branches.
Pollen, the fertilising dust-like powder produced by the anthers of flowering-plants.
Pollinate, to apply pollen to the stigma or receptive surface of the female organ.
Proliferation, generally an abnormal growth, as a leaf or flower growing out of another leaf or flower, *e.g.* the Rose in some cases.

Protein, a complex organic compound formed in leaves or grain, *e.g.* the aleurone layer of a paddy grain; flesh-forming substance.
Prothallus, a leafy expansion resulting from a germinated spore and bearing sexual organs. See *Cryptogam*, also *Spore*.
Protoplasm, a transparent substance in the cells of animal and plant tissue; the basic principle of live matter.
Pseudobulb, a thickened fleshy stem, as in many orchids.
Pulchellus, pretty; pulcher, pulchra or pulchrum, beautiful.
Pukka or **Pucka** (India), pure, true, genuine.
Pulp, the juicy or fleshy tissue of fruit.
Pulque, a national drink in Mexico made from the sap of Agave.
Pulse, a common name for small peas or gram crops.
Quintane, a long, narrow hoe, similar to a mamoty. See *Tools*, etc.
Rabi-crop, spring crop in India, sown during the north-east monsoon and harvested in March or April.
Raceme, an inflorescence in which a number of flowers with short pedicels (stalks) of equal length are arranged on a common axis or central stalk.
Rachis, the midrib of a pinnate or compound leaf or frond; the axis of an inflorescence.
Radical, proceeding from or pertaining to the root.
Radicle, the rudimentary root of the embryo; the first part to appear through the seed in germination. See p. 12.
Ragi, the crop or season in India from June to end of August.
Rata, foreign (Sinh.); used as a prefix to vernacular names. See *Seemai*.
Ratoon, a shoot (or shoots) from a plant or crop that has been cut down, as Sugar-cane and Indigo after first harvest; a secondary crop.
Resin, a solid inflammable exudation from certain plants, valuable in varnishes, etc. See *Gum and resins*.
Resting period, a dormant state, usually assumed in dry season in tropics.
Retting, steeping in water in order to free fibre from the cellular portion, as in the preparation of fibre from jute, flax, coconut-husks, etc.
Rhizome, a creeping stem, above or under ground, with buds or eyes, and scales representing leaves, often resembling a tuberous root, *e.g.* Canna, Ginger.
Root-pressure, the forcing up of fluids into the xylem (wood elements) and to all parts of the plant or tree. It has not yet been discovered how this is effected, though osmotic force is considered to play some part in it.
Rootstock, erect short rhizome; a cluster of rhizomes, as in herbaceous plants.
Rostellum, an extension of the stigma of certain orchids, e.g. *Vanilla*.
Rudiment, an imperfectly developed and functionally useless organ.
Runner, a stolon; an elongated lateral shoot, rooting at the nodes, as strawberry, sweet-potato, etc.
Ryot, Indian (goiya, Sinh., fellaheen, Arabic), a peasant cultivator or farmer.
Samara, a dry winged fruit, e.g. *Dipterocarpus*, *Myroxylon*, etc.
Sap, the juice of a plant; water, with its dissolved mineral substances, absorbed by the roots and forced through the stem, etc., to the leaves.
Sapling, a young tree.
Sapwood, the new wood of an exogenous tree through which the sap is conducted; the alburnum or portion of stem outside the heartwood.
Saprophytic, living on decaying vegetable matter; a saprophyte. See *Fungi*.
Scion, the upper shoot or twig used in grafting and representing the kind it is desired to propagate, the lower portion growing on its own roots being the stock.
Seedling, a young plant raised from seed, as distinct from a grafted or budded plant or a rooted cutting.
Seemai, foreign (Tamil), used as a prefix to vernacular names. See also *Rata*.
Seet, the sediment obtained after the extraction of indigo from the leaves and stems.
Shuck, sick, not thriving; "out of sorts" or "off colour."
Snail-plants, those whose flowers are supposed to be fertilised by snails; malacophilous plants (*q.v.*).
Solitary flowers, not in sprays or clusters; borne singly.
Spathe, a large bract or sheath enclosing a flower-spike or spadix, as in palms, aroids, etc. The male and female fls., usually separate, are embedded in the spadix.
Spawn, mycelium; mushroom "spawn" made up in the form of brickettes, etc., permeated with the mycelium of the mushroom-fungus.
Species, the unit of classification, a collection of species forming a genus; groups of genera form Natural Orders, which are grouped into Tribes, Divisions, etc.

Speciosa, handsome, showy, used in specific names.
Spectabilis, remarkable, conspicuous.
Sporangium, a receptacle containing spores, as in ferns, etc. See *Ferns*.
Spore, the analogue of seed in fungi or cryptogams; a cell capable of direct germination into a prothallus (*q.v.*).
Sporophyll, a form of leaf or frond which bears spores, as in "flowering" ferns.
Sport, a variation originating usually from a bud or seed.
Sprout, the germination of seed; the development of new shoots.
Stamen, the pollen-bearing part of a flower, consisting usually of filament and anther.
Staminode, an aborted or sterile stamen, often petaloid, *e.g.* Canna.
Sterile, barren, as a flower destitute of pistil or anthers.
Stigma, the receptive part of the pistil or style which receives the pollen.
Stilt-roots, roots developed from the stem of certain trees, reaching to the ground and then developing normal roots, as in Mangroves, Pandanus, etc.
Stock, in grafting, the root-bearing plant or portion in which the scion is inserted.
Stoma (plural stomata), a breathing pore or aperture in the epidermis of leaves, etc., through which respiration and transpiration take place (*q.v.*).
Stool, a plant from which offsets or layers are taken; growing in clusters, *e.g.* Banana.
Storax, a fragrant gum-resin obtained from certain trees and used in incense, medicine, scent, etc. See *Benzoin*, *Bursera*, etc.
Strain, a variety which differs from the race or type.
Strike, to emit roots, as from a cutting.
Stringy-bark, an Australian general term for different species of *Eucalyptus*.
Strobilus, a cone; an inflorescence made up of imbricated scales, as in Firs, "Horse-tails" (*Equisetum*), *Selaginella*, etc.
Style, the part of a pistil, usually attenuated, connecting the ovary and stigma.
Sucker, a shoot arising below ground; a new shoot from an old stem.
Symbiosis, the living together of different organisms with benefit to one or both, as a mycorhiza growth on roots of orchids. See *Mycorhiza*.
Talipot (from Sanskrit and Hindu), the popular name of a very large, erect, stout palm (*Corypha umbraculifera*), a native of the moist low-country of Ceylon and Malabar. It grows to a height of 60–80 ft., with a straight cylindrical trunk, 3–4 ft. in diameter, surmounted by a crown of immense fan-like leaves, which are used for olas, large fans, umbrellas, sun-shades, etc. A single leaf-blade at full size may be as much as 16 ft. in diameter, with a stout petiole 15 ft. long. At the age of about 20–30 years it produces an enormous pyramidal panicle of creamy white inflorescence, 14–15 ft. high, which first appears as an erect pole issuing from the centre of the crown; this is followed about 8 months later by the large, hard, marble-like fruit, followed about 12 months later by the death of the palm. The leaves become gradually smaller as the palm approaches the flowering stage, withering and falling back along the stem, and finally dropping off, leaving only the fruiting panicle at the top. See p. 156.
Tambili, the immature yellow nut of the "King-coconut," furnishing a pleasant refreshing drink. See *Kurumba*.
Tap-root, the primary descending root, forming a direct continuation of the radicle.
Tari. See *Toddy* or *Palm-sugar*.
Tendril, a slender, filiform, spiral or hooked organ arising from stem or foliage, affording plants a means of obtaining support by climbing trees or other bodies.
Terrestrial, applied to orchids, etc., which normally grow on the ground as distinct from those which grow on trees (epiphytes).
Testa, the outer hard coat of a seed.
Thein, the active principle of tea. See *Caffeine*.
Theobromine, the active principle of cocoa. See *Alkaloids*.
Tillering, spreading by sending out stems from the base, as in corn, rice, etc.
Toddy (from tari of India), the unfermented sweet juice of certain palms.
Touchwood, dry combustible wood permeated with dry fungus mycelium.
Transpiration, the exhalation of watery vapour from the stomata of plants, as distinct from evaporation. See p. 12.
Tuber, a thickened rhizome or stem, usually underground, bearing "eyes" or buds, *e.g.* Arrowroot. See *Bulb*.
Tussock, a tuft of grass, or grass-like plants; cespitose.
Umbel, an inflorescence in which a number of pedicels arise from the same point, like the ribs of an umbrella.
Unisexual flower, a flower containing either stamens or pistil, but not both, the other

sex being in a separate flower on the same or different plant. See *Dioecious* and *Monoecious*, also p. 11.

Variety, a sport or variation subordinate to a species; a jat.

Vascular system, distinct tissues of a stem, branch or leaf which are especially concerned with the conduction and circulation of water and sap and give rigidity; in young shoots, it is generally formed of *vascular bundles* or *strands* (xylem and phloem). In dicotyledonous stems these unite and form a cylinder of wood; in monocotyledons they are scattered throughout the pith, as plainly seen in a cross-section of a palm stem. In leaves they are known as *veins*.

Veins, fine fibro-vascular strands traversing the blade of a leaf, either in parallel or net form. They vary in arrangement in different species or genera, and are therefore of importance in the identification of plants. See preceding paragraph.

Vitamines, organised ferments or substances of unknown composition present in certain foodstuffs, as in fresh or green vegetables and uncooked fruits, certain oils and fats. They are in minute quantities, and their absence leads to certain maladies or disorders. Several vitamines have been defined, as (A) *anti-ricketts*, as in fresh butter, lettuce, and cod-liver oil (deficient in margarine, lard, skim milk and bran); (B) *anti-beri-beri*, as in seeds, bran, eggs, etc. (deficient in polished rice, tinned foods, butter, etc.); (C) *anti-scorbutic* or *anti-scurvy*, as in fresh vegetables and fruit (deficient in tinned food, dried peas, lentils, haricot-beans, manufactured lime-juice); also (D), (E) and others. A mixed diet is therefore important, especially in growing persons or animals, in order to ensure correct nutrition and freedom from certain maladies. Vitamines generally are adversely affected or even destroyed by heat or desiccation.

Vulgaris, common; used in names of common species.

Wal (Sinh.), common or wild, used as a prefix in vernacular names.

Water plants, those growing in water, immersed wholly or in part. See *Aquatic plants*.

Weed, a plant in the wrong place; generally a plant which rapidly reproduces itself in large numbers and, if not checked, supersedes or destroys cultivated crops, or interferes with their profitable cultivation; a pest. See *Weeds*.

Weeping, pendulous branches, as Weeping Willow (*Salix*), *Cupressus funebris*.

Wel or **vel**, climber or creeper; used as affix in Sinhalese names.

Whorls, circles of 3 or more leaves, shoots or branches, each circle issuing from one point, *e.g.* in branching of the Kapok-tree.

Witchbroom or **Witches' Broom**, a disease of plants characterised by an abnormal growth of broom-like stunted twigs. See p. 345.

Xerophyte, a plant with special characters adapted to withstand drought by reduced transpiration; especially a plant naturally suited to a dry region; a desert plant, also succulent or Cactaceous plants.

Xylem, the wood element of a vascular bundle; the true wood, associated chiefly with the upward conduction and storage of water.

Yala-crop (Ceylon), the S.W. monsoon crop, sown in April or May and harvested in August or September. See *Maha crop*.

SOME SIGNS AND ABBREVIATIONS USED IN BOTANY

Flowers may be male (♂), female (♀), or hermaphrodite (☿), *i.e.* both male and female in one flower. They are said to be indefinite (∞) when the number, as stamens, is too great to be easily counted. A hybrid is indicated by ×, which also denotes magnifying power. † equals a doubtful species, § is a section, as the division of a genus, and = denotes a synonym. Lvs. indicate leaves, fl. flowers, fr. fruit, sp. species, spp. two or more species, and N.O. Natural Order.

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